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JOURNAL OF PALEONTOLOGY

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CONTENTS

Microfauna from the Carapita formation of Venezuela ..... *E. S. Franklin* 301

Permian trilobite genera ..... *J. Marvin Weller* 320

Cretaceous Foraminifera from the Marlbrook marl of Arkansas ..... *J. A. Cushman and W. H. Deaderick* 328

Smaller Foraminifera from the Porters Creek formation (Paleocene) of Illinois ..... *Chalmer L. Cooper* 343

Lower Carboniferous corals of the genera *Rotiphyllum* and *Permia* *R. G. S. Hudson* 355

Trilobite genera *Goldius* and *Arctinurus* in the Silurian of Iowa and Illinois ..... *A. K. Miller and A. G. Unklesbay* 363

Eocene Foraminifera from Cape Blanco, Oregon ..... *O. L. Bandy* 366

Pendent graptolites of Arkansas, Oklahoma and Texas ..... *Charles E. Decker* 378

Bibliography and index to new genera, species and varieties of Foraminifera for the year 1941 ..... *Hans E. Thalmann* 387

REVIEWS 405

SOCIETY RECORDS AND ACTIVITIES 411

ERRATA 416

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VOLUME 18 JULY, 1944 NUMBER 4

MICROFAUNA FROM THE CARAPITA FORMATION OF VENEZUELA

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ABSTRACT.—Ninety-eight species of Foraminifera are listed from the Carapita formation of northeastern Venezuela. Two new species and two new varieties are described. Data are presented to correlate the fauna with lower Oligocene faunas of Mexico and Cuba.

INTRODUCTION

THE CARAPITA formation comprises a series of sandstones and shales some 8,000 or 9,000 feet thick in the District of Libertad, State of Anzoategui, northeastern Venezuela. The fauna listed here is from outcrops of the Carapita formation in the vicinity of Rio Oregano.

Inasmuch as the stratigraphic position of the Carapita formation is in dispute and since a further investigation of the foraminiferal fauna has yielded information which throws considerable light on this problem, the results of this study are presented in this paper.

The difficulty of determining the exact geologic age of the Carapita formation in terms of world-wide stratigraphy is fully recognized. However, it is possible, where faunas are homeotopic, to make fairly accurate age correlations. In the opinion of the author, this fauna from the Carapita formation is lower Oligocene in age and can be correlated with the lower Oligocene (Alazan) of Mexico and the lower Oligocene (Finca Adelina) of Cuba.

The Alazan formation of the Tampico embayment of Mexico has been shown by Vaughan,[1] Cooke,[2] and Nuttall[3] to be lower Oligocene in age. The "Alazan" of Cushman[4] is now known to include beds of upper Eocene age as well as beds of lower Oligocene age. In this paper, the term Alazan is used as by Nuttall.[5] The Finca Adelina fauna of Cuba was first described in 1936 by Palmer and Bermúdez.[6] It is their opinion that it is lower Oligocene in age.

The following table presents the basis for

[1] Vaughan, T. W., 1924, Geol. Soc. Am. Bull., vol. 35, p. 731.

[2] Cooke, C. W., 1928, U. S. Nat. Mus. Proc., vol. 73, pp. 1–11.

[3] Nuttall, W. L. F., 1932, Jour. Paleontology, vol. 6, pp. 3–35.

[4] Cushman, J. A., 1924, U. S. Nat. Mus. Proc., vol. 66, art. 30, pp. 1–4; 1925, Cushman Lab., Foram. Res., Contr., vol. 1, pp. 4–8; 1926, idem, pp. 81–84, 88; idem, vol. 3, pp. 111–116; 1926, U. S. Nat. Mus. Proc., vol. 67, art. 25, pp. 1–24; 1927, idem, vol. 70, art. 16, pp. 1–8; 1927; idem, vol. 72, p. 6; 1927, Jour. Paleontology, vol. 1, pp. 147–172.

[5] Nuttall, op. cit.

[6] Palmer, D. K. and P. J. Bermùdez, 1936, Soc. Cubana Hist. Nat. Mem., vol. 10, pp. 227–316.

correlating the fauna from the Carapita formation with the known faunas from the Alazan formation of Mexico and the Finca Adelina formation of Cuba. The known stratigraphic range of each species described is also indicated. In preparing this table, the comparisons were made with specimens collected from Mexico and Cuba.

ACKNOWLEDGMENTS

The author wishes to express his gratitude to Mr. John A. Hendricks for making possible this study, to Dr. Irene McCulloch for her generous assistance, to Mr. Stanley Wissler for his aid in editing the manuscript, and to Dr. H. G. Schenck for making available the topotypes of the species described

FORAMINIFERA OF LOWER OLIGOCENE AGE COMMON TO THE CARAPITA FORMATION, SHOWING KNOWN STRATIGRAPHIC RANGE

Species and Varieties	Alazan	Cuba	Eocene	Oligocene	Miocene	Pliocene	Quaternary
Bathysiphon carapitanus Hedberg	×			×			
Ammodiscus incertus (d'Orbigny)	×	×	×	×	×	×	×
Glomospira charoides (Jones and Parker)			×	×	×	×	×
Lituotuba lituiformis (H. B. Brady)			×	×	×	×	×
Haplophragmoides emaciatus (H. B. Brady)			×	×	×	×	×
Ammobaculites hendricksi Franklin, n. sp.				×			
Ammobaculites hockleyensis Cushman and Applin			×	×			
Ammobaculites humboldti (Reuss)			×	×	×	×	×
Cyclammina cancellata H. B. Brady		×	×	×	×	×	×
Cyclammina elegans Cushman and Jarvis				×	×	×	×
Textularia dentimargingta Nuttall	×			×			
Textularia martini Pijpers			×	×			
Textularia mexicana Cushman		×		×	×	×	×
Textularia recta Cushman			×	×			
Textularia zapotensis Cole			×	×			
Verneuilina mexicana Nuttall	×	×	×	×			
Gaudryina gardnerae Cushman			×	×			
Gaudryina jacksonensis Cushman	×	×	×	×			
Gaudryina triangularis Cushman				×	×	×	×
Heterostomella cubensis D. K. Palmer and Bermúdez		×		×			
Clavulina venezuelana Nuttall			×	×			
Dorothia asiphonia (Andreae)				×			
Dorothia nuttalli Cushman	×	×		×			
Karreriella bradyi (Cushman)	×	×	×	×	×	×	×
Listerella curta (Galloway and Morrey)		×		×			
Textulariella barrettii (Jones and Parker)	×		×	×	×	×	×
Textulariella cf. *Textulariella pacifica* Cushman				×	×	×	×
Rzehakina venezuelana Hedberg				×			
Quinqueloculina lamarckiana d'Orbigny				×	×	×	×
Massilina decorata Cushman			×	×			
Sigmoilina orinocoensis Hedberg				×			
Sigmoilina tenuis (Czjzek)	×	×		×	×	×	×
Miliola cf. *M. jacksonensis* Cushman			×	×			
Trochammina irregularis White			×	×			
Robulus budensis (Hantken)	×			×			
Robulus calcar (Linné)		×		×	×	×	×
Robulus clericii (Fornasini)			×	×	×		
Robulus formosus (Cushman)	×	×		×	×	×	×
Robulus limbosus (Ruess)	×	×	×	×	×		
Robulus pseudocultratus Cole			×	×			
Robulus pseudovortex Cole			×	×			
Robulus subpapillosus (Nuttall)	×			×			

Species and Varieties	Alazan	Cuba	Eocene	Oligocene	Miocene	Pliocene	Quaternary
Planularia venezuelana Hedberg				×			
Marginulina cocoaensis carapitana Franklin, n. var.				×			
Dentalina cocoaensis (Cushman)	×		×	×			
Dentalina jacksonensis (Cushman and Applin)	×		×	×			
Dentalina soluta Reuss	×		×	×			
Nodosaria acuminata Hantken	×	×		×			
Nodosaria carinata (Neugeboren)	×			×			
Nodosaria longiscata d'Orbigny	×	×	×	×	×	×	
Nodosaria raphanistrum var. *caribbeana* Hedberg	×	×		×			
Nodosaria sp. A				×			
Nodosaria sp. B				×			
Nodosaria vertebralis (Batsch)	×	×	×	×	×	×	×
Pseudoglandulina comatula (Cushman)	×	×		×	×	×	×
Saracenaria italica carapitana Franklin, n. var.	×	×		×			
Lagena costata (Williamson)		×	×	×	×	×	×
Lagena striata strumosa Reuss		×	×	×	×	×	×
Nonionella tatumi Howe				×			
Bulimina affinis Cushman	×			×	×		
Bulimina bleckeri Hedberg	×			×			
Bulimina inflata Seguenza	×	×	×	×	×	×	×
Bulimina sculptilis Cushman	×	×	×	×			
Globobulimina pacifica Cushman			×	×	×	×	×
Bolivina alazanensis Cushman	×	×		×	×		
Bolivina carapitana Hedberg				×			
Uvigerina byramensis Cushman			×	×			
Uvigerina canariensis nuttalliana Franklin, n. var.	×	×		×			
Uvigerina gardnerae nuttalliana Howe and Wallace	×		×	×			
Uvigerina jacksonensis Cushman	×		×	×			
Uvigerina mexicana Nuttall	×	×		×			
Uvigerina pygmaea d'Orbigny	×		×	×			
Ellipsonodosaria verneuili (d'Orbigny)	×	×	×	×	×		
Valvulineria venezuelana Hedberg				×			
Gyroidina aff. *G. soldanii* d'Orbigny	×		×	×	×	×	×
Eponides byramensis (Cushman)	×		×	×			
Eponides crebbsi Hedberg				×			
Eponides umbonatus (Reuss)	×	×	×	×	×	×	×
Siphonina jacksonensis Cushman and Applin	×		×	×			
Siphonina tenuicarinata Cushman	×	×	×	×	×		
Cancris nuttalli D. K. Palmer and Bermúdez	×	×		×			
Ceratobulimina alazanensis Cushman and Harris	×			×	×		
Pulvinulinella culter mexicana Cole	×	×	×	×	×	×	×
Cassidulina carapitana Hedberg				×			
Cassidulina subglobosa H. B. Brady	×	×	×	×	×	×	×
Chilostomella oolina Schwager				×	×	×	×
Sphaeroidina variabilis Reuss	×	×		×	×	×	×
Globigerina bulloides d'Orbigny	×	×	×	×	×	×	×
Globigerina concinna Reuss	×			×	×	×	
Globigerinella cf. *G. aequilateralis* (H. B. Brady)				×	×	×	×
Globorotalia spinulosa Cushman	×		×	×			
Anomalina alazanensis Nuttall	×	×		×			
Anomalina jacksonensis texana (Cushman and Applin)			×	×			
Anomalina mecatepecensis Nuttall	×			×			
Anomalina nolani Hedberg				×			
Anomalina pariana Hedberg				×			
Cibicides americanus (Cushman)	×	×	×	×	×		
Cibicides mantaensis (Galloway and Morrey)				×			

by Hedberg[7] from the Carapita formation. The illustrations were drawn by Miss Dorothy Franklin. The holotypes of new species and varieties will be deposited in the files of the Allan Hancock Foundation, University of Southern California, at Los Angeles, California.

SYSTEMATIC DESCRIPTIONS

Family RHIZAMMINIDAE
Genus BATHYSIPHON M. Sars, 1878
BATHYSIPHON CARAPITANUS Hedberg
Plate 44, figure 9

Bathysiphon carapitanus Hedberg, 1937, Jour. Paleontology, vol. 11, p. 665, pl. 90, fig. 1.

This species is very close to, if not identical with, specimens of *Bathysiphon* observed by the author in the Alazan formation of Mexico.

Family AMMODISCIDAE
Genus AMMODISCUS Reuss, 1861
AMMODISCUS INCERTUS (d'Orbigny)
Plate 44, figure 1

[7] Hedberg, H. D., 1937, Jour. Paleontology, vol. 11, pls. 90–92, pp. 661–697.

Operculina incerta d'Orbigny, 1839, in de la Sagra's Hist. phys., pol., et. nat. de l'Ile de Cuba, Foraminifères, p. 49, pl. 6, figs. 16, 17.
Ammodiscus incertus, Cushman, 1918, U. S. Nat. Mus. Bull. 104, pt. 1, p. 95, pl. 39, figs. 1–8.

The specimens of this species, which are generally distorted, show considerable variation in the width of the whorls and general outline of the test.

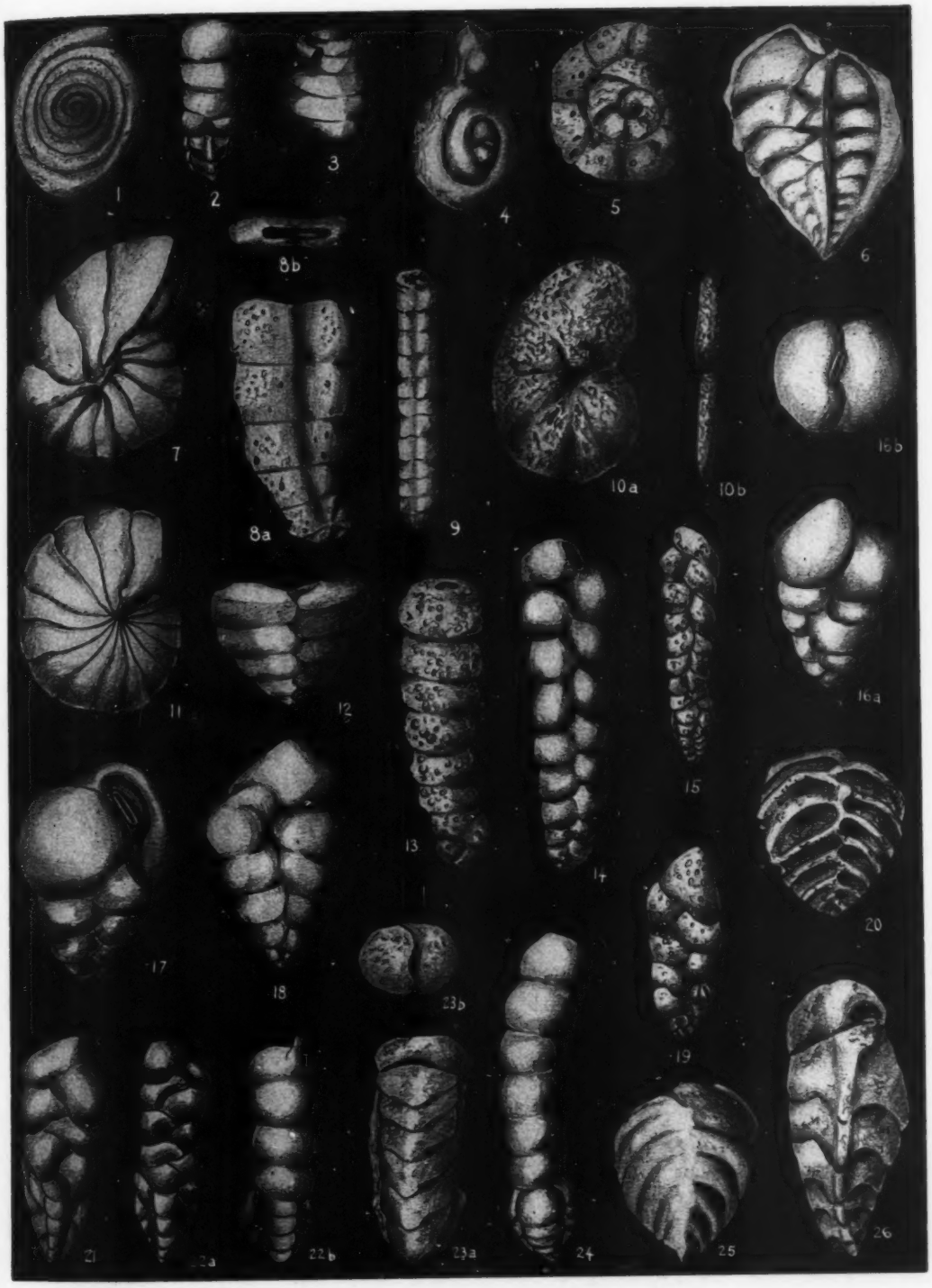
Genus GLOMOSPIRA Rzehak, 1888
GLOMOSPIRA CHAROIDES (Jones and Parker)
Plate 44, figure 3

Trochammina squamata charoides Jones and Parker, 1860, Geol. Soc. London Quart. Jour., p. 304.
Ammodiscus charoides, H. B. Brady, 1884, Rept. Voy. Challenger, Zool., vol. 9, p. 334, pl. 38, figs. 10–16.
Glomospira charoides, White, 1928, Jour. Paleontology, vol. 2, p. 187, pl. 27, fig. 7.
Glomospira charoides corona Cushman and Jarvis, 1928, Cushman Lab. Foram. Res. Contr., vol. 4, p. 89, pl. 12, figs. 9–11.

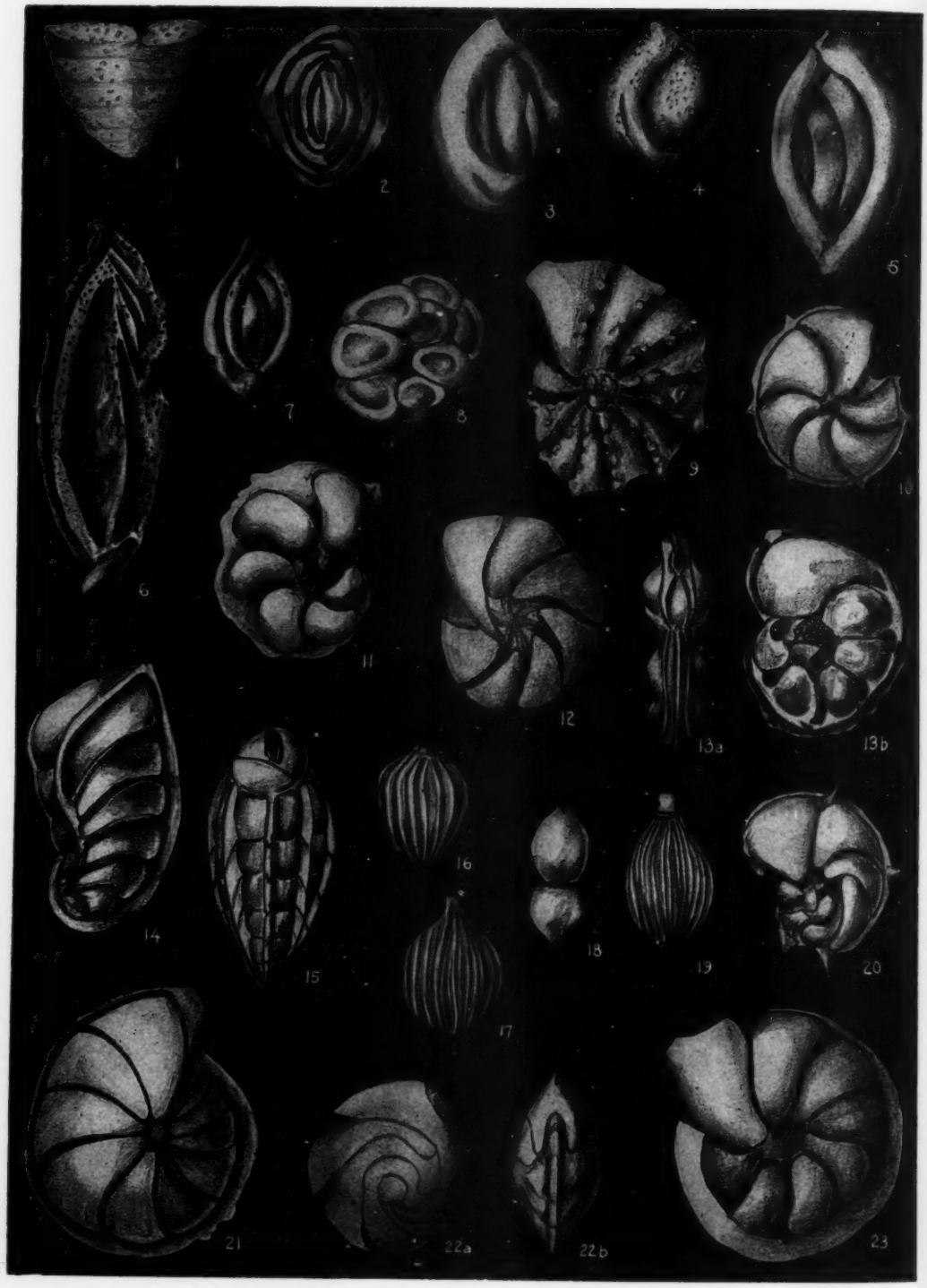
There are records of this species from the Cretaceous and Eocene of Mexico as well as from Recent oceans. It occurs only sparingly in the Carapita formation.

EXPLANATION OF PLATE 44

FIG. *1*—*Ammodiscus incertus* (d'Orbigny), ×90. (p. 304)
2—*Listerella curta* (Galloway and Morrey). ×30. (p. 307)
3—*Glomospira charoides* (Jones and Parker), ×40. (p. 304)
4—*Lituotuba lituiformis* (H. B. Brady), ×40. (p. 305)
5—*Haplophragmoides emaciatus* (H. B. Brady), ×40. (p. 305)
6—*Textularia zapotensis* Cole, ×60. (p. 306)
7—*Cyclammina elegans* Cushman and Jarvis, ×10. (p. 306)
8—*Ammobaculites hendricksi* Franklin, n. sp.; ×40; *a*, side view; *b*, apertural view. (p. 305)
9—*Bathysiphon carapitanus* Hedberg, ×20. (p. 304)
10—*Ammobaculites hockleyensis* Cushman and Applin, ×40; *a*, side view; *v*, apertural view. (p. 305)
11—*Cyclammina cancellata* H. B. Brady, ×10. (p. 306)
12—*Textulariella barrettii* (Jones and Parker), ×30. (p. 307)
13—*Ammobaculites humboldti* (Reuss), ×40. (p. 306)
14—*Textularia recta* Cushman, ×50. (p. 306)
15—*Dorothia nuttalli* Cushman, ×90. (p. 307)
16—*Karreriella bradyi* (Cushman), ×40; *a*, side view; *b*, apertural view. (p. 307)
17—*Verneuilina mexicana* Nuttall, ×40. (p. 306)
18—*Textularia martini* Pijpers, ×90. (p. 306)
19—*Dorothia asiphonia* (Andreae), ×40. (p. 307)
20—*Textularia mexicana* Cushman, ×50. (p. 306)
21—*Gaudryina triangularis* Cushman, ×40. (p. 307)
22—*Heterostomella cubensis* D. K. Palmer and Bermúdez, ×50; *a*, front view; *b*, side view. (p. 307)
23—*Gaudryina gardnerae* Cushman, ×40; *a*, side view; *b*, apertural view. (p. 306)
24—*Clavulina venezuelana* Nuttall, ×60. (p. 307)
25—*Textularia dentimarginata* Nuttall, ×50. (p. 306)
26—*Gaudryina* (*Pseudogaudryina*) *jacksonensis* Cushman, ×30. (p. 307)



Franklin—Foraminifera from Venezuela



Franklin—Foraminifera from Venezuela

Genus LITUOTUBA Rhumbler, 1895

LITUOTUBA LITUIFORMIS (H. B. Brady)

Plate 44, figure 4

Trochammina lituiformis H. B. Brady, 1879, Quart. Jour. Micr. Soc., vol. 19, p. 59, pl. 16.

Lituotuba lituiformis, Cushman, 1928, U. S. Nat. Mus. Proc., vol. 80, p. 10, pl. 2, figs. 11a, b.

Test small, tubular, early portion glomerate, later portion evolute; wall finely arenaceous; aperture simple, round, terminal. Length, 0.70 mm.

Specimens of this species from the Carapita formation differ from those described from Recent oceans in lacking the characteristic external constriction of the second chamber.

Family LITUOLIDAE

Genus HAPLOPHRAGMOIDES Cushman, 1910

HAPLOPHRAGMOIDES EMACIATUS (H. B. Brady)

Plate 44, figure 5

Haplophragmium emaciatum, H. B. Brady, 1884, Rept. Voy. Challenger, Zool., vol. 9, p. 305, pl. 33, figs. 26–28.

Haplophragmoides emaciatum, Cushman, 1929, Cushman Lab. Foram. Res. Contr., vol. 5, p. 78, pl. 12, fig. 3.

Haplophragmoides emaciatum, Nuttall, 1935, Jour. Paleontology, vol. 9, p. 122, pl. 14, fig. 1.

The specimens of this species from the Carapita formation are generally distorted due to compression.

Genus AMMOBACULITES Cushman, 1910

AMMOBACULITES HENDRICKSI Franklin, n. sp.

Plate 44, figures 8a, b

Test large, much compressed, nearly completely evolute; chambers few, about 4 or 5 in the uniserial portion, enlarging rapidly in breadth and height; sutures nearly straight, indistinct; test somewhat depressed along medial axis; wall finely arenaceous; aperture narrow, linear, terminal.

Dimensions: Length, 1.51 mm.; width across last-formed chamber, 0.65 mm.; width across initial coil, 0.25 mm.; thickness, 0.05 mm.

This form closely resembles *A. culyeri* Tappan but differs in that the later chambers are more enlarged, sutures are less distinct, and the initial coil is smaller.

AMMOBACULITES HOCKLEYENSIS Cushman and Applin

Plate 44, figures 10a, b

Ammobaculites hockleyensis Cushman and Applin, 1926, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 163, pl. 6, figs. 2a, b.

This is the first record of this species from a horizon younger than the Eocene.

EXPLANATION OF PLATE 45

FIG. *1*—*Textulariella* cf. *T. pacifica* Cushman, ×20. (p. 308)
2—*Rzehakina venezuelana* Hedberg, ×90. (p. 308)
3—*Quinqueloculina lamarckiana* d'Orbigny, ×40. (p. 308)
4—*Sigmoilina orinocoensis* Hedberg, ×50. (p. 308)
5—*Sigmoilina tenuis* (Czjzek), ×90. (p. 308)
6—*Miliola* cf. *M. jacksonensis* Cushman, ×40. (p. 308)
7—*Massalina decorata* Cushman, ×40. (p. 308)
8—*Trochammina irregularis* White, ×30. (p. 308)
9—*Robulus subpapillosus* (Nuttall), ×40. (p. 310)
10—*Robulus calcar* (Linné), ×40. (p. 309)
11—*Robulus budensis* (Hantken), ×40. (p. 309)
12—*Robulus pseudovortex* Cole, ×40. (p. 310)
13—*Planularia venezuelana* Hedberg, ×70; *a*, apertural view; *b*, side view. (p. 310)
14—*Saracenaria italica carapitana* Franklin, n. var. ×80. (p. 312)
15—*Bulimina sculptilis* Cushman, ×60. (p. 314)
16—*Pseudoglandulina comatula* (Cushman), ×60. (p. 312)
17—*Lagena costata* (Williamson), ×70. (p. 313)
18—*Nodosaria* sp. B, ×40. (p. 312)
19—*Lagena striata strumosa* Reuss, ×60. (p. 313)
20—*Robulus formosus* (Cushman), ×20. (p. 309)
21—*Robulus limbosus* (Reuss), ×30. (p. 309)
22—*Robulus clericii* (Fornasini), ×30; *a*, side view; *b*, apertural view. (p. 309)
23—*Robulus pseudocultratus* Cole, ×40. (p. 309)

AMMOBACULITES HUMBOLDTI (Reuss)
Plate 44, figure 13

Spirolina humboldti Reuss, 1851, Deutsche geol. Gesell., Zeitschr. vol. 3, p. 65, pl. 3, figs. 17, 18.
Ammobaculites humboldti, Cushman, 1910, U. S. Nat. Mus. Bull. 71, pt. 1, p. 114, fig. 176

This form has been described from the Oligocene of Europe and the Eocene of Venezuela and Panama, as well as from Recent oceans.

Genus CYCLAMMINA H. B. Brady, 1876
CYCLAMMINA CANCELLATA H. B. Brady
Plate 44, figure 11

Cyclammina cancellata H. B. Brady, 1876, in Norman, Roy. Soc. London Proc., vol. 25, p. 214.—Hedberg, 1937, Jour. Paleontology, vol. 11, p. 666.

The form from the Carapita formation agrees closely with specimens of the species from Recent oceans.

CYCLAMMINA ELEGANS Cushman and Jarvis
Plate 44, figure 7

Cyclammina elegans Cushman and Jarvis, 1932, U. S. Nat. Mus. Proc., vol. 80, art. 14, p. 13, pl. 3, figs. 6a, b.

This species occurs only rarely in the Carapita formation.

Family TEXTULARIIDAE
Genus TEXTULARIA Defrance, 1824
TEXTULARIA DENTIMARGINATA Nuttall
Plate 44, figure 25

Textularia dentimarginata Nuttall, 1932, Jour. Paleontology, vol. 6, p. 6, pl. 1, fig. 2.

In the Carapita formation this species can be readily distinguished from *T. mexicana* Cushman in that it is more flattened and has fewer chambers.

TEXTULARIA MARTINI Pijpers
Plate 44, figure 18

Textularia martini Pijpers, 1933, Geol. Pal. Bonaire, p. 57, figs. 6–10.—Nuttall, 1935, Jour. Paleontology, vol. 9, p. 123, pl. 14, fig. 5.

Specimens of this species are rare in the Carapita formation.

TEXTULARIA MEXICANA Cushman
Plate 44, figure 20

Textularia mexicana Cushman, 1922, U. S. Nat. Mus. Bull. 104, pt. 3, p. 17, fig. 9.—Hedberg, 1937, Jour. Paleontology, vol. 11, p. 666, pl. 90, fig. 4.
?Textularia mexicana cubana D. K. Palmer and Bermúdez, 1936, Soc. cubana hist. nat. Mem., vol. 10, p. 241, pl. 13, fig. 6; pl. 19, figs. 9, 10.

A comparison of specimens of *T. mexicana cubana* D. K. Palmer and Bermúdez with specimens of *T. mexicana* Cushman from Mexico and Venezuela suggests that these forms are closely related.

TEXTULARIA RECTA Cushman
Plate 44, figure 14

Textularia recta Cushman, 1923, U. S. Geol. Survey Prof. Paper 133, p. 17, pl. 1, fig. 2—Cushman 1935, idem, Prof. Paper 181, p. 7, pl. 1, figs. 8, 9.

This species occurs only sparingly in the Carapita formation.

TEXTULARIA ZAPOTENSIS Cole
Plate 44, figure 6

Textularia mexicana Cole (not Cushman), 1927, Bull. Am. Paleontology, vol. 14, no. 51, p. 11, pl. 5, fig. 5.
Textularia zapotensis Cole, May 20th, 1929, Corrigenda slip to same publication.
Textularia zapotensis, Nuttall, 1930, Jour. Paleontology, vol. 4, p. 275—Howe, 1939, Louisiana Dept. Cons. Geol. Bull. 14, p. 32, pl. 1, figs. 1, 2.

Specimens of this species are rare in the Carapita formation.

Family VERNEUILINIDAE
Genus VERNEUILINA d'Orbigny, 1840
VERNEUILINA MEXICANA Nuttall
Plate 44, figure 17

Verneuilina mexicana Nuttall, 1932, Jour. Paleontology, vol. 6, p. 6, pl. 2, figs. 1, 2.—D. K. Palmer and Bermúdez, 1936, Soc. cubana hist. nat. Mem., vol. 10, p. 242.

The only records of this species are from horizons of lower Oligocene age.

Genus GAUDRYINA d'Orbigny, 1840
GAUDRYINA GARDNERAE Cushman
Plate 44, figures 23a, b

Gaudryina gardnerae Cushman, 1933, Cushman Lab. Foram. Res. Contr., vol. 9, p. 2, pl. 1, figs. 1a–c.—Cushman, 1935, U. S. Geol. Survey, Prof. Paper 181, p. 10, pl. 2, figs. 7a, b.

It may be that this form is synonymous with *G. triangularis* Cushman.

GAUDRYINA (PSEUDOGAUDRYINA) JACKSONENSIS Cushman
Plate 44, figure 26

Gaudryina jacksonensis Cushman, 1926, Cushman Lab. Foram. Res. Contr., vol. 2, p. 33, pl. 5, figs. 1a, b.—Nuttall, 1932, Jour. Paleontology, vol. 6, p. 7, pl. 2, fig. 5.—Cushman, 1935, U. S. Geol. Survey Prof. Paper 181, p. 9, pl. 2, figs. 4–6.—D. K. Palmer and Bermúdez, 1936, Soc. cubana hist. nat. Mem., vol. 10, p. 243.

Only a few specimens referable to this species were observed.

GAUDRYINA TRIANGULARIS Cushman
Plate 44, figure 21

Gaudryina triangularis Cushman, 1911, U. S. Nat. Mus. Bull. 71, pt. 2, p. 65, figs. 104a–c (in text).

This species is common in the Carapita formation.

Genus HETEROSTOMELLA Reuss, 1865
HETEROSTOMELLA CUBENSIS D. K. Palmer and Bermúdez
Plate 44, figures 22a, b

Heterostomella cubensis D. K. Palmer and Bermúdez, 1936, Soc. cubana hist. nat. Mem., vol. 10, p. 244, pl. 13, figs. 1–3; pl. 14, fig. 20.
Heterostomella halconi Hedberg, 1937, Jour. Paleontology, vol. 11, pl. 90, figs. 9a–c.

A study of the topotypes deposited at Stanford University, California, reveals that the Venezuelan and Cuban species are identical, hence priority is given to *H. cubensis* Palmer and Bermúdez.

Family VALVULINIDAE
Genus CLAVULINA d'Orbigny, 1826
CLAVULINA VENEZUELANA Nuttall
Plate 44, figure 24

Clavulina venezuelana Nuttall, 1935, Jour. Paleontology, vol. 9, p. 123, pl. 14, fig. 9.

This is the first record of this species from the Oligocene of the Caribbean region.

Genus DOROTHIA Plummer, 1931
DOROTHIA ASIPHONIA (Andreae)
Plate 44, figure 19

Gaudryina siphonella asiphonia Andreae, 1884, Geol. Specialkarte Elsass-Lothr. Abh., vol. 2, p. 200, pl. 7, fig. 7.
Dorothia asiphonia, Hedberg, 1937, Jour. Paleontology, vol. 11, pl. 90, figs. 8a, b.

DOROTHIA NUTTALLI Cushman
Plate 44, figure 15

Gaudryina asiphonia Nuttall (not Andreae), 1932, Jour. Paleontology, vol. 6, p. 7, pl. 2, fig. 3.—Hadley, 1934, Bull. Am. Paleontology, vol. 20, no. 70A, p. 8, pl. 1, fig. 6.
Dorothia nuttalli Cushman, 1936, Cushman Lab. Foram. Res., Spec. Pub. 6, p. 29, pl. 4, fig. 12.—D. K. Palmer and Bermúdez, 1936, Soc. cubana hist. nat. Mem., vol. 10, p. 246.—Hedberg, 1937, Jour. Paleontology, vol. 11, p. 668, pl. 90, figs. 8a, b.

Specimens of this species are common in the Carapita formation.

Genus KARRERIELLA Cushman, 1933
KARRERIELLA BRADYI (Cushman)
Plate 44, figures 16a, b

Gaudryina pupoides H. B. Brady, 1884 (not d'Orbigny, 1840), Rept. Voy. Challenger, Zool., vol. 9, p. 378, pl. 46, figs. 1–4.
Gaudryina bradyi Cushman, 1911, U. S. Nat. Mus. Bull. 71, pt. 1, p. 67, fig. 107.
Textularia chapapotensis Cole, 1928, Bull. Am. Paleontology, vol. 14, no. 53, p. 6, pl. 2, fig. 9.
Dorothia bradyi, Nuttall, 1935, Jour. Paleontology, vol. 9, p. 123.
Karreriella bradyi, Cushman, 1937, Cushman Lab. Foram. Res. Spec. Pub. 8, p. 135, pl. 16, figs. 6–11.

Specimens of this species occur only rarely in the Carapita formation.

Genus LISTERELLA Cushman, 1933
LISTERELLA CURTA (Galloway and Morrey)
Plate 44, figure 2

Clavulina curta Galloway and Morrey, 1929, Bull. Am. Paleontology, vol. 15, no. 55, p. 34, pl. 5, fig. 5.—Cushman, 1929, Cushman Lab. Foram. Res. Contr., vol. 5, p. 81, pl. 12, fig. 10.—D. K. Palmer and Bermúdez, 1936, Soc. cubana hist. nat. Mem., vol. 10, p. 244.—Hedberg, 1937, Jour. Paleontology, vol. 11, p. 668.
Listerella curta, Cushman, 1936, Cushman Lab. Foram. Res. Spec. Pub. 6, p. 38.

The form of this species observed in the Carapita formation is smaller than the usual specimens of this species.

Genus TEXTULARIELLA Cushman, 1927
TEXTULARIELLA BARRETTII (Jones and Parker)
Plate 44, figure 12

Textularia barrettii Jones and Parker, 1863, Rept. British Assoc., Newcastle Meeting, pp. 80, 105.

Textulariella barrettii, Pijpers, 1933, Geog. geol. Mededeel., Phys. geol. reeks 8, p. 57, figs. 11–13.—Hedberg, 1937, Jour. Paleontology, vol. 11, p. 668, pl. 90, fig. 11.

This species occurs only rarely in the Carapita formation.

TEXTULARIELLA cf. T. PACIFICA Cushman
Plate 45, figure 1

Textulariella pacifica Cushman, 1937, Cushman Lab. Foram. Res. Spec. Pub. 8, p. 67, pl. 7, figs. 11–13.—Cushman and McCulloch, 1939, Allan Hancock Pacific Expeditions, vol. 6, p. 97, pl. 9, figs. 11, 12.

Two specimens are tentatively assigned to this species. The resemblance is close except that the Venezeula form differs from the Pacific form in size and shape of the apertural face.

Family SILICINIDAE
Genus RZEHAKINA Cushman, 1927
RZEHAKINA VENEZUELANA Hedberg
Plate 45, figure 2

Rzehakina venezuelana Hedberg, 1937, Jour. Paleontology, vol. 11, p. 669, pl. 90, fig. 12.

The following description is from Hedberg:

Test elliptical, planispiral, compressed; each chamber forming half a coil. About nine slender chambers, attentuated at both ends. Initial chambers usually raised. Wall clear, siliceous.

Family MILIOLIDAE
Genus QUINQUELOCULINA d'Orbigny, 1826
QUINQUELOCULINA LAMARCKIANA d'Orbigny
Plate 45, figure 3

Quinqueloculina lamarckiana d'Orbigny, 1839, in De La Sagra's Hist. Phys., Pol. et Nat. de l'Ile de Cuba, Foraminifères, p. 189, pl. 11, figs. 14, 15.
Quinqueloculina auberiana d'Orbigny, 1839, in De La Sagra's Hist. Phys., Pol. et Nat. de l'Ile de Cuba, Foraminifères, p. 193, pl. 12, figs. 1–3.

This species is rare in the Carapita formation.

Genus MASSILINA Schlumberger, 1893
MASSILINA DECORATA Cushman
Plate 45, figure 7

Massilina decorata Cushman, 1922, U. S. Geol. Survey Prof. Paper 129, p. 143, pl. 34, fig. 7.

Test elliptical, flattened; sutures indistinct; periphery slightly rounded; surface rather smooth; apertural end narrowing to a small cylindrical neck.

Genus SIGMOILINA Schlumberger, 1887
SIGMOILINA ORINOCOENSIS Hedberg
Plate 45, figure 4

Sigmoilina orinocoensis Hedberg, 1937, Jour. Paleontology, vol. 11, p. 669, pl. 90, figs. 13a, b.

The following description is from Hedberg:

Test small, stout, sigmoid in cross-section. Chambers few; sides covered with fine arenaceous matter so that only last two chambers are distinct. Periphery broadly rounded to truncate. Last chamber projecting at apertural end. Aperture elliptical with blunt tooth.

SIGMOILINA TENUIS (Czjzek)
Plate 45, figure 5

Quinqueloculina tenuis Czjzek, 1847, Haidinger's Naturwiss. Abh., vol. 2, p. 149, pl. 13, figs. 31–34.
Sigmoilina tenuis, Cushman, 1929, Cushman Lab. Foram. Res. Contr., vol. 5, p. 81, pl. 12, figs. 12–14.

Specimens of this species are rare in the Carapita formation.

Genus MILIOLA Lamarck, 1804
MILIOLA cf. M. JACKSONENSIS Cushman
Plate 45, figure 6

Miliola jacksonensis Cushman, 1933, Cushman Lab. Foram. Res. Contr., vol. 9, p. 2, pl. 1, figs. 2, 3.—Cushman, 1935, U. S. Geol. Survey Prof. Paper 181, p. 13, pl. 3, figs. 4–6.

Several incomplete specimens are tentatively assigned to this species.

Family TROCHAMMINIDAE
Genus TROCHAMMINA Parker and Jones, 1859
TROCHAMMINA IRREGULARIS White
Plate 45, figure 8

Trochammina irregularis White, 1928, Jour. Paleontology, vol. 2, p. 307, pl. 42, fig. 1.—Nuttall, 1930, Jour. Paleontology, vol. 4, p. 279, pl. 23, fig. 4.

Specimens of this species in the Carapita formation are usually distorted due to compression.

Family LAGENIDAE
Genus ROBULUS Montfort, 1808
ROBULUS BUDENSIS (Hantken)
Plate 45, figure 11

Robulina budensis Hantken, 1875 (1876), Magyr. kir. földt int. évkön., vol. 4, p. 49, pl. 7, fig. 1.
Robulus budensis, Cushman, 1927, Jour. Paleontology, vol. 1, p. 151, pl. 23, fig. 11.
Cristellaria budensis, Nuttall, 1932, Jour. Paleontology, vol. 6, p. 9, pl. 1, fig. 5.—D. K. Palmer and Bermúdez, 1936, Soc. cubana hist. nat. Mem., vol. 10, p. 253.

This form is common in the Carapita formation.

ROBULUS CALCAR (Linné)
Plate 45, figure 10

Nautilus calcar Linné, 1758, Systemata naturae, ed. 10, p. 709; ed. 12, p. 1162, no. 272.
Lenticulina calcar, Hadley, 1934, Bull. Am. Paleontology, vol. 20, no. 70A, p. 11.
Cristellaria calcar, Nuttall, 1928, Geol. Soc. London Quart. Jour., vol. 84, p. 86, pl. 5, fig. 8.
Robulus calcar, Galloway and Morrey, 1929, Bull. Am. Paleontology, vol. 15, no. 55, p. 20, pl. 2, fig. 10.—Hedberg, 1937, Jour. Paleontology, vol. 11, p. 670.

Specimens of this species are common in the Carapita formation.

ROBULUS CLERICII (Fornasini)
Plate 45, figures 22a, b

Cristellaria clericii Fornasini, 1895, "*Christellaria clericii*, n. sp.," Bologna, text figure; Roy. Acad. Sci. Bologna Mem., ser. 5, vol. 9, p. 65, fig. 17 (in text).
Robulus duracina Galloway and Morrey (not Stache), 1929, Bull. Am. Paleontology, vol. 5, no. 55, p. 21, pl. 2, fig. 13.
Robulus clericii, Cushman, 1929, Cushman Lab. Foram. Res. Contr., vol. 5, p. 84, pl. 12. figs. 16, 17.—Hedberg, 1937, Jour. Paleontology, vol. 11, p. 669.

This form is a distinctive species in the Carapita formation. The rather peculiar curvature of the sutures is a characteristic feature. According to Cushman the species normally has 8 chambers, the Venezuelan specimens generally have fewer chambers, 6 or 7 in number.

ROBULUS FORMOSUS (Cushman)
Plate 45, figure 20

Cristellaria calcar H. B. Brady (not Linné), 1884, Rept. Voy. Challenger, Zool., vol. 9' p. 551, pl. 70, figs. 13, 14 (not 9–12).—Flint, 1897 (1899), U. S. Nat. Mus. Rept., p. 318, pl. 66, fig. 1 (central figure).
Cristellaria formosa Cushman, 1923, U. S. Nat. Mus. Bull. 104, pt. 4, p. 110, pl. 29, fig. 1; pl. 30, fig. 6.—Nuttall, 1928, Geol. Soc. London Quart. Jour., vol. 84, p. 86, pl. 5, fig. 5.—Nuttall, 1935, Jour. Paleontology, vol. 6, p. 9, pl. 1, fig. 10.—D. K. Palmer and Bermúdez, 1936, Soc. cubana hist. nat. Mem., vol. 10, p. 249.
Lenticulina formosa, Hadley, 1934, Bull. Am. Paleontology, vol. 20, no. 70A, p. 11, pl. 1, fig. 11.
Robulus formosus, Cushman and Jarvis, 1930, Jour. Paleontology, vol. 4, p. 358, pl. 32, fig. 10.

The published descriptions and illustrations of this species reveal considerable variation. It may be that the Oligocene forms are distinct.

ROBULUS LIMBOSUS (Reuss)
Plate 45, figure 21

Robulina limbosa Reuss, 1863 (1864), Akad. Wiss. Wien Sitz., vol. 48, pt. 1, p. 55, pl. 6, figs. 69a, b.
Cristellaria limbosa, Nuttall, 1932, Jour. Paleontology, vol. 6, p. 11.—D. K. Palmer and Bermúdez, 1936, Soc. cubana hist. nat. Mem., vol. 10, p. 250.
Robulus limbosus, Ellisor, 1933, Am. Assoc. Petroleum Geologists, Bull., vol. 17, no. 11, pl. 2, figs. 1a, b.—Cushman, 1933, U. S Nat. Mus. Bull. 161, pt. 2, p. 3, pl. 1, figs. 4–6; pl. 2, figs. 5a, b.—Cushman, 1935, U. S. Geol. Survey Prof. Paper 181, p. 16, pl. 6, fig. 5.—Coryell and Rivero, 1940, Jour. Paleontology, vol. 14, p. 332, pl. 43, figs. 17a, b.

This species in the Carapita formation exhibits considerable variation, particularly in the closeness of coiling, the number of chambers, and the development of the peripheral keel.

ROBULUS PSEUDOCULTRATUS Cole
Plate 45, figure 23

Robulus pseudocultratus Cole, 1927, Bull. Am. Paleontology, vol. 14, p. 19, pl. 1, fig. 5.—Cushman and Masters, 1936, Jour. Paleontology, vol. 10, p. 510, pl. 74, figs. 13a, b.—Howe, 1939, Louisiana Dept. Cons. Geol. Bull. 14, p. 41, pl. 5, figs. 2, 3.

Originally described by Cole from the Guayabal formation of Mexico, this species has also been recorded from the Eocene of California and Louisiana. This is the first published record of this species from a horizon younger than the Eocene.

ROBULUS PSEUDOVORTEX Cole
Plate 45, figure 12

Robulus pseudovortex Cole, 1927, Bull. Am. Paleontology, vol. 14, no. 51, p. 19, pl. 1, fig. 12.

A comparison of specimens of this species from Mexico with the form observed in the Carapita formation reveals that they are identical.

ROBULUS SUBPAPILLOSUS (Nuttall)
Plate 45, figure 9

Cristellaria subpapillosa Nuttall, 1932, Jour. Paleontology, vol. 6, p. 12, pl. 1, fig. 12.

This is the only published record of this species outside the Alazan formation of Mexico. It occurs only rarely in the Carapita formation.

Genus PLANULARIA Defrance, 1824
PLANULARIA VENEZUELANA Hedberg
Plate 45, figures 13a, b

Planularia venezuelana Hedberg, 1937, Jour. Paleontology, vol. 11, p. 670, pl. 90, figs. 14a, b.

This species was originally described by Hedberg from the Carapita formation. It has been reported to occur also in the Agua Salada clays of western Venezuela.

Genus MARGINULINA d'Orbigny, 1826
MARGINULINA COCOAENSIS
CARAPITANA Franklin, n. var.
Plate 46, figure 8

Var. of *Marginulina cocoaensis* Cushman, 1925, Cushman Lab. Foram. Res. Contr., vol. 1, p. 67, pl. 10, figs. 9, 10.

Test elongate, not compressed; chambers large, inflated; sutures distinct; costate prominent, few, about 6 in number; texture, except for costae, fairly smooth; aperture at peripheral side of apertural face, radiate, at end of prominent neck.

Dimensions: Length, 1.10 mm.; breadth, 0.48 mm.

This form differs from *M. cocoaensis* in not being compressed and in having fewer and more prominent costae. It can be distinguished from *M. cocoaensis venezuelana* by its larger chambers, fewer costae, and inflated character.

Genus DENTALINA d'Orbigny, 1826
DENTALINA COCOAENSIS (Cushman)
Plate 46, figure 18

Nodosaria sp. Cushmam and Applin, 1926, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 170, pl. 7, fig. 17.
Nodosaria cocoaensis Cushman, 1925, Cushman Lab. Foram. Res. Contr., vol. 1, p. 66, pl. 10; figs. 5, 6.—Cushman, 1927. Jour. Paleontology, vol. 1, p. 153, pl. 24, fig. 1.
Dentalina cocoaensis, Ellisor, 1933, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 2, fig. 5.—Nuttall, 1932, Jour. Paleontology, vol. 6, p. 14.—Cushman, 1935, U. S. Geol. Survey Prof. Paper 181, p. 19, pl. 8, figs. 1, 2.

This species was originally described from the upper Eocene of Alabama. Later investigations have shown it to be widespread in the Eocene of the Gulf coast and present in the type locality of the Alazan formation of Mexico.

DENTALINA JACKSONENSIS
(Cushman and Applin)
Plate 46, figure 10

Nodosaria jacksonensis Cushman and Applin, 1926, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 170, pl. 7, figs. 14–16.—Cushman, 1927, Jour. Paleontology, vol. 1, p. 153, pl. 24, fig. 3.—Cole, 1928, Bull. Am. Paleontology, vol. 14, no. 53, p. 208, pl. 3, fig. 12.—Cole and Ponton, 1930, Florida Geol. Survey Bull. 5, p. 33, pl. 6, fig. 1.
Dentalina jacksonensis, Cushman and Ponton, 1932, Cushman Lab. Foram. Res. Contr., vol. 8, p. 55, pl. 7, figs. 10, 11.—Cushman, 1935, U. S. Geol. Survey Prof. Paper 181, p. 20, pl. 8, figs. 7–9.—Cushman and Masters, 1936, Jour. Paleontology, vol. 10, p. 511, pl. 75, figs. 3–5.—Coryell and Embich, 1937, Jour. Paleontology, vol. 11, p. 298, pl. 42, fig. 8.—Howe, 1939, Louisiana Dept. Cons. Geol. Bull. 14, p. 44, pl. 6, fig. 2.

This species has been recorded at many stations in the Eocene of the United States as well as from the Eocene and Oligocene of Mexico.

DENTALINA SOLUTA Reuss
Plate 46, figure 12

Dentalina soluta Reuss, 1851, deutsche geol. Gesell. Zeitschr., vol. 3, p. 60, pl. 3, fig. 4., D. K. Palmer and Bermúdez, 1936, Soc. cubana hist. nat. Mem., vol. 10, p. 263.
Nodosaria cf *N. soluta*, Nuttall, 1932, Jour. Paleontology, vol. 6, p. 16, pl. 3, fig. 14.

Test elongate, slender, gently curved; chambers subglobular, separated by distinct

constrictions; wall smooth; aperture radiate.

A close examination reveals that the Venezuelan and Mexican specimens are identical. The record of this species from Cuba by Palmer and Bermúdez is included in the synonymy with some question.

Genus NODOSARIA Lamarck, 1812
NODOSARIA ACUMINATA Hantken
Plate 46, figure 4

Nodosaria acuminata Hantken, 1875 (1876), Magyr. földt. int. évkön., vol. 4, p. 23, pl. 2, fig. 9.—Cushman, 1927, Jour. Paleontology, vol. 1, p. 155, pl. 24, fig. 9; 1929, Cushman Lab. Foram. Res. Contr., vol. 5, p. 86, pl. 13, figs. 5, 6.—D. K. Palmer and Bermúdez, 1936, Soc. cubana hist. nat. Mem., vol. 10, p. 266.

Specimens of this species are rare in the Carapita formation.

NODOSARIA CARINATA (Neugeboren)
Plate 46, figure 7

Dentalina carinata Neugeboren (not d'Orbigny), 1856, Denkschr. K. Akad. Wiss. Wien, vol. 12, pt. 2, p. 91, pl. 4, fig. 17.
Nodosaria aff. *N. carinata*, Nuttall, 1932, Jour. Paleontology, vol. 6, p. 16, pl. 3, fig. 11.
Nodosaria nuttalli Hedberg, 1937, Jour. Paleontology, vol. 11, p. 673, pl. 91, fig. 6.

Test elongate, gently curved; chambers numerous, slightly inflated; initial chamber rounded, with prominent spine; later chambers increasing in size; costae thin, continuous, about 6 in number; sutures indistinct; aperture radiate.

Dimensions: Length, 0.65 mm.; diameter, 0.10 mm.

A close examination of specimens of this species from Mexico and Venezuela reveals that they are identical.

NODOSARIA LONGISCATA d'Orbigny
Plate 46, figures 1, 2

Nodosaria longiscata d'Orbigny, 1846, Foram. Foss. Vienne, p. 32, pl. 1, figs. 10–12.—Plummer, 1927, Univ. Texas Bull. 2644, p. 82, pl. 4, figs. 17a, b.—Nuttall, 1928, Geol. Soc. London Quart. Jour., vol. 84, pl. 4, fig. 13.—Cushman, 1929, Cushman Lab. Foram. Res. Contr., vol. 5, p. 86, pl. 12, figs. 25, 26.—Nuttall, 1930, Jour. Paleontology, vol. 4, p. 283.—Howe and Wallace, 1932, Louisiana Dept. Cons. Geol. Bull. 2, p. 35, pl. 7, fig. 8.—Nuttall, 1932, Jour. Paleontology, vol. 6, p. 15.—Cushman, 1932, Florida Geol. Survey Bull. 9, p. 62.—Nuttall, 1935, Jour. Paleontology, vol. 9, p. 125.—Hedberg, 1937, Jour. Paleontology, vol. 11, p. 671, pl. 91, figs. 3, 4.

(not) *Nodosaria longiscata*, Cole and Ponton, 1930, Florida Geol. Survey Bull. 5, p. 33, pl. 6, fig. 4.—Cole and Gillespie, 1930, Bull. Am. Paleontology, vol. 15, no. 57B, p. 8, pl. 5, fig. 1; pl. 3, fig. 9.
Nodosaria arundinea, Guppy, 1904, Geol. Mag., Dec. 5, vol. 1, pl. 8, figs. 14, 15.—Cole, 1928, Bull. Am. Paleontology, vol. 14, no. 53, p. 20.—Galloway and Morrey, 1929, Bull. Am. Paleontology, vol. 15, no. 55, p. 16, pl. 1, fig. 15.—Cushman, 1929, Cushman Lab. Foram. Res. Contr., vol. 5, pl. 13, figs. 1, 2.
(?) *Nodosaria filiformis* Cushman (not d'Orbigny), 1921, U. S. Geol. Survey Prof. Paper 129, pl. 30, figs. 1–3.
(?) *Nodosaria ewaldi*, Cushman, 1927, Jour. Paleontology, p. 153, pl. 24 (not fig. 2).—Coryell and Rivero, 1940, Jour. Paleontology, vol. 14, p. 330, pl. 42, figs. 10, 11.

Test very elongate, slender; chambers numerous, elongate; sutures narrow, transverse, depressed; wall smooth; aperture round, radiate.

Dimensions: Length, up to 1.50 mm.; breadth, 0.10 mm.

The differences between *N. longiscata* and *N. arundinea* are not definite enough to warrant separation. On the basis of priority, the specimens from the Carapita formation are listed under the former name.

NODOSARIA RAPHANISTRUM CARIBBEANA Hedberg
Plate 46, figure 5

Nodosaria raphanistrum cribbeana Hedberg, 1937, Jour. Paleontology, vol. 11, p. 671, pl. 91, fig. 1.

Test elongate, gently curved; chambers rounded, inflated, separated by distinct constrictions; costae fine, continuous, about 15 or 16 in number; aperture radiate.

Dimensions: Length, 2.10 mm.; breadth, 0.23 mm.

NODOSARIA SP. A
Plate 46, figures 3a, b

Test elongate, with four distinct, thin raised costae which form obtuse angles; chambers numerous, the later ones more elongate than the earlier ones; sides nearly parallel; sutures slightly curved; surface, except for costae, smooth.

Dimensions: Length, 1.12 mm.; breadth, 0.23 mm.

This form closely resembles *Dentalina quadrulata* Cushman and Laiming, but dif-

fers in that the sides are parallel and the costae are straight.

NODOSARIA SP. B
Plate 45, figure 18

(?)*Nodosaria* sp. Cushman, 1933, U. S. Nat. Mus. Bull. 161, pt. 2, p. 14, pl. 3, fig. 11.

Test small, composed of two chambers; chambers distinct, globular; sutures distinct; initial chamber with a small basal spine; surface smooth; aperture at end of a slender, tapering neck.

Dimensions: Length, 0.55 mm.; breadth, 0.15 mm.

This form superficially resembles *N. blanpiedi* Ellis, but lacks the ornamentation characteristic of that species. It may be the same as that observed by Cushman (1933) from the tropical Pacific ocean.

NODOSARIA VERTEBRALIS (Batsch)
Plate 46, figure 6

Nautilus (*Orthoceras*) *vertebralis* Batsch, 1791 Conch. des Seesandes, p. 3, no. 6, pl. 2, figs. 6a, b.

Nodosaria sp. A, D. K. Palmer and Bermúdez 1936, Soc. cubana hist. nat. Mem., vol. 10 p. 270.

Nodosaria vertebralis, Nuttall, 1932, Jour. Paleontology, vol. 6, p. 15, pl. 3, fig. 9.—Hedberg, 1937, Jour. Paleontology, vol. 11, p. 671, pl. 91, fig. 2.

Specimens of this species are common in the Carapita formation.

Genus PSEUDOGLANDULINA Cushman, 1929
PSEUDOGLANDULINA COMATULA (Cushman)
Plate 45, figure 16

Nodosaria comatula Cushman, 1923, U. S. Nat. Mus. Bull. 104, pt. 4, p. 83, pl. 14, fig. 5.—Nuttall, 1928, Geol. Soc. London Quart. Jour., vol. 84, p. 84, pl. 5, fig. 3.

Glandulina comata, Galloway and Morrey, 1929, Bull. Am. Paleontology, vol. 15, no. 55, p. 13, pl. 1, figs. 7a, b.

Pseudoglandulina gallowayi Cushman, 1929, Cushman Lab. Foram. Res. Contr., vol. 5, p. 87, pl. 13, fig. 13.—Cushman and Hobson, 1935. Cushman Lab. Foram. Res. Contr., vol. 11, p. 59, pl. 8, figs. 17a, b.

Pseudoglandulina comatula, Nuttall, 1932, Jour. Paleontology, vol. 6, p. 16.—D. K. Palmer and Bermúdez, 1936, Soc. cubana hist. nat. Mem., vol. 10, p. 274.—Hedberg, 1937, Jour. Paleontology, vol. 11, p. 673, pl. 91, figs. 9, 10.

Genus SARACENARIA Defrance, 1824
SARACENARIA ITALICA
CARAPITANA Franklin, n. var.
Plate 45, figure 14

Saracenaria italica Cushman (not Defrance) 1929, Cushman Lab. Foram. Res. Contr.,

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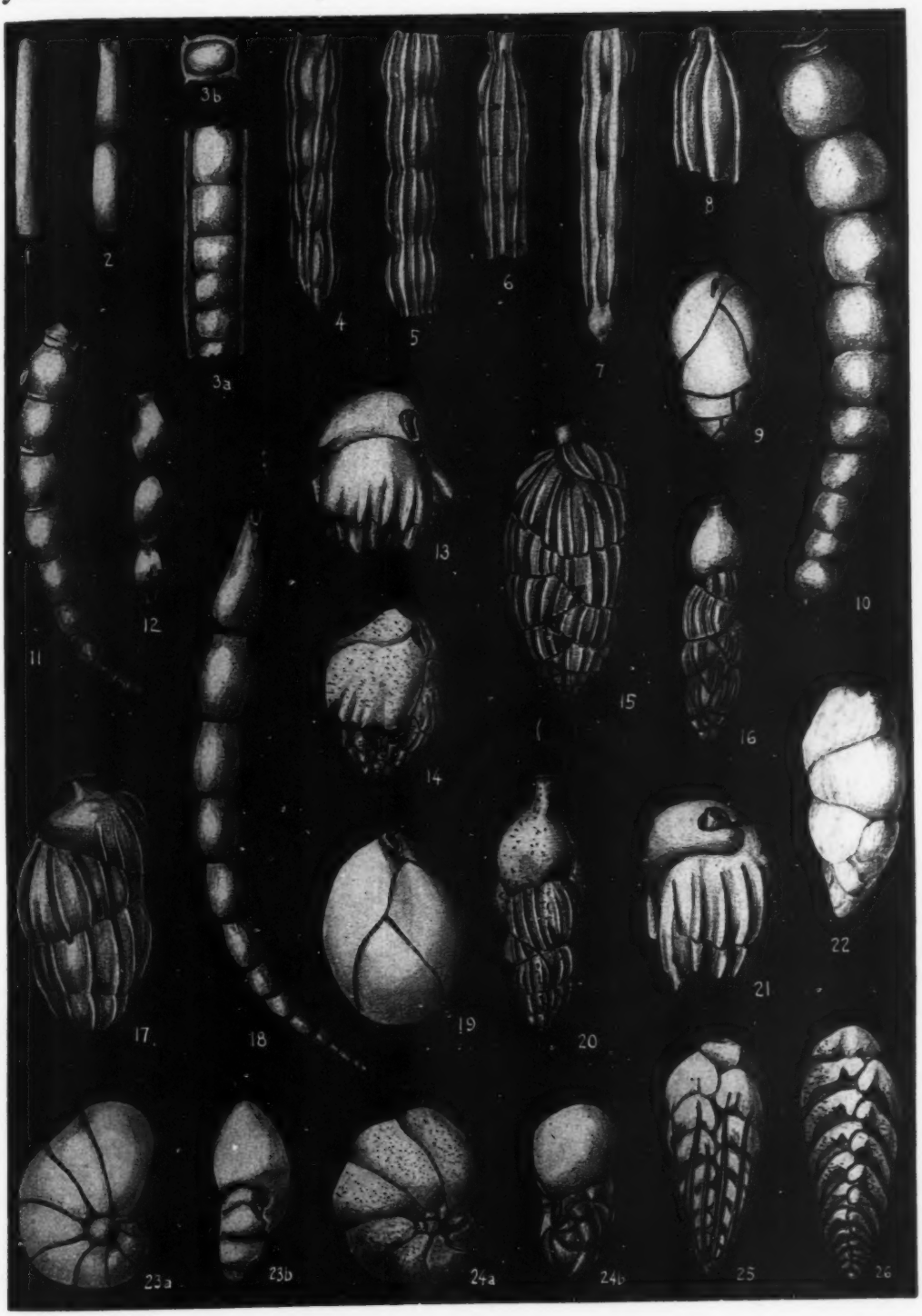
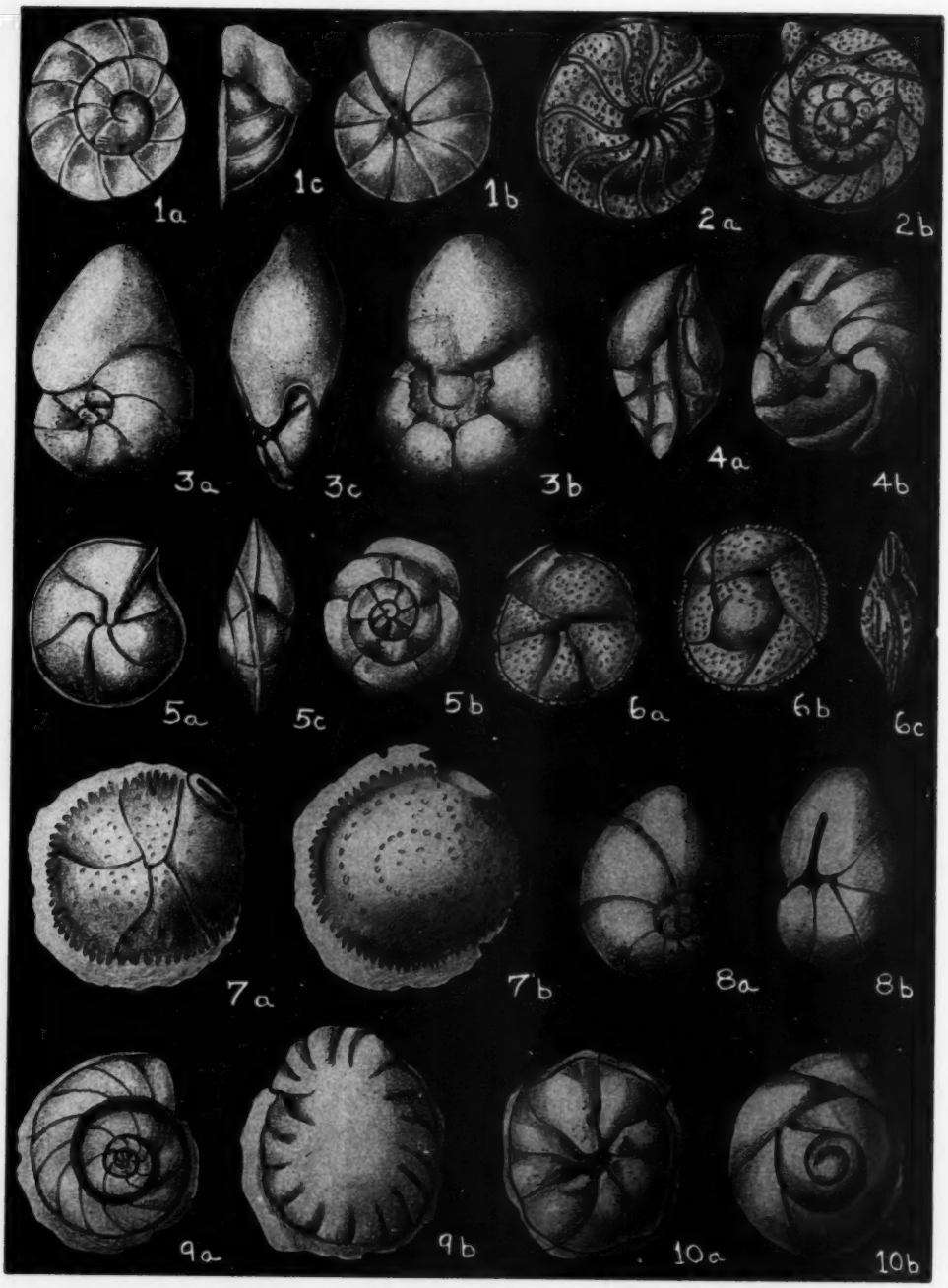
EXPLANATION OF PLATE 46

FIGS. *1, 2*—*Nodosaria longiscata* d'Orbigny, ×20. (p. 311)
3—*Nodosaria* sp. A, ×30; *a*, side view; *b*, end view. (p. 311)
4—*Nodosaria acuminata* Hantken, ×40. (p. 311)
5—*Nodosaria raphanistrum caribbeana* Hedberg, ×20. (p. 311)
6—*Nodosaria vertebralis* (Batsch), ×20. (p. 312)
7—*Nodosaria carinata* (Neugeboren), ×80. (p. 311)
8—*Marginulina cocoaensis carapitana* Franklin, n. var., ×20. (p. 310)
9—*Bulimina affinis* d'Orbigny, ×60. (p. 314)
10—*Dentalina jacksonensis* (Cushman and Applin), ×50. (p. 310)
11—*Ellipsonodosaria verneuili* (d'Orbigny), ×50. (p. 315)
12—*Dentalina soluta* Reuss, ×30. (p. 310)
13—*Bulimina inflata* Seguenza, ×50. (p. 314)
14—*Bulimina bleckeri* Hedberg, ×80. (p. 314)
15—*Uvigerina gardnerae nuttalliana* Howe and Wallace, ×50. (p. 315)
16—*Uvigerina byramensis* Cushman, ×100. (p. 314)
17—*Uvigerina jacksonensis* Cushman, ×40. (p. 315)
18—*Dentalina cocoaensis* (Cushman), ×50. (p. 310)
19—*Globobulimina pacifica* Cushman, ×40. (p. 314)
20—*Uvigerina pygmaea* d'Orbigny, ×70. (p. 315)
21—*Uvigerina mexicana* Nuttall, ×40. (p. 315)
22—*Uvigerina canariensis nuttalliana* Franklin, n. var., ×80. (p. 314)
23—*Nonionella tatumi* Howe, ×100; *a*, side view; *b*, apertural view. (p. 313)
24—*Valvulineria venzuelana* Hedberg, ×40; *a*, side view; *b*, apertural view. (p. 315)
25—*Bolivina carapitana* Hedberg, ×90. (p. 314)
26—*Bolivina alazanensis* Cushman, ×70. (p. 314)



Franklin—Foraminifera from Venezuela



Franklin—Foraminifera from Venezuela

vol. 5, p. 88, pl. 13, fig. 14.—Nuttall, 1932, Jour. Paleontology, vol. 6, p. 11.
?Saracenaria italica D. K. Palmer and Bermúdez, 1936, Soc. cubana hist. nat. Mem., vol. 10, p. 276.

Test small, early portion close-coiled, later becoming uncoiled; periphery acute, keeled; chambers numerous, about 7 visible; in later uncoiled stage, the test is triangular in cross sections; sutures narrow, gently curved, not depressed; wall smooth; aperture slit at peripheral angle.

Dimensions: Length, 0.53 mm.; width of apertural face 0.30 mm.

A study of the literature reveals that various forms have been ascribed to *S. italica* Defrance. The specimens from the Carapita formation and the Alazan formation closely resemble the form figured by Cushman (1929) from Venezuela, but show no affinity to the form illustrated by Cushman (1931) from the Saratoga chalk of Arkansas. In view of this variation of interpretation of the species, the varietal form *S. italica*, var. *carapitana* is proposed. This variety is very close to *S. senni* Hedberg, but lacks the spinose initial end characteristic of that species.

Genus LAGENA Walker and Jacob, 1798

LAGENA COSTATA (Williamson)

Plate 45, figure 17

Enstolenia costata Williamson, 1858, Recent Foram. Great Britain, p. 9, pl. 1, fig. 18.
Lagena costata, Reuss, 1862 (1863), Akad. Wiss. Wien. Sitz., vol. 46, pt. 1, p. 329, pl. 4, fig. 54.
Lagena costata, Wright, 1891, Royal Irish Acad. Proc., ser. 3, vol. 1, p. 479.

This species is reported to be widely distributed throughout the Tertiary but the only record of it from the Cretaceous is without a figure. It may be that the present specific limits for the species are too wide and further study is undoubtedly needed.

LAGENA STRIATA STRUMOSA REUSS

Plate 45, figure 19

Lagena strumosa Reuss, 1858, Deutsche geol. Gesell. Zeitschr., p. 434.—Reuss, 1862, Akad. Wiss. Wein Sitz., vol. 46, pt. 1, p. 328, pl. 4, fig. 49.
Lagena striata strumosa, Cushman, 1913, U. S. Nat. Mus. Bull. 71, pt. 3, p. 20, pl. 7, figs. 7–10.

Family NONIONIDAE

Genus NONIONELLA Cushman, 1926

NONIONELLA TATUMI Howe

Plate 46, figures 23a, b

Nonionella tatumi Howe, 1930, Jour. Paleontology, vol. 4, p. 330, pl. 27, figs. 6a–c.—Ellisor, 1933, Am. Assoc. Petroleum Geologist Bull., vol. 17, pl. 2, fig. 11.—Cushman, 1939, U. S. Geol. Survey Prof. Paper 191, p. 31, pl. 8, fig. 8.

The following description is taken from Howe:

Test subtrochoid, small, periphery broadly rounded, usually nine chambers in the last-formed coil, distinct, dorsal side not completely involute. Sutures nearly straight. Ventral side involute with the last-formed chamber having an extension the end of which is generally divided into three or more small lobes which completely cover the umbilical area. Aperture low, arched, at the base of the last-formed chamber.

Dimensions: Length, 0.30 mm.; breadth, 0.23 mm.; thickness, 0.10 mm.

EXPLANATION OF PLATE 47

FIGS. *1a–c—Gyroidina* aff. *G. soldanii* d'Orbigny, ×70; *a*, dorsal view; *b*, ventral view; *c*, apertura. view. (p. 315)
2a, b—Eponides crebbsi Hedberg, ×80; *a*, ventral view; *b*, dorsal view. (p. 316)
3a–c—Cancris nuttalli (D. K. Palmer and Bermúdez), ×40; *a*, dorsal view; *b*, ventral view; *c*, apertural view. (p. 316)
4a, b—Cassidulina carapitana Hedberg, ×100; *a*, side view; *b*, apertural view. (p. 317)
5a–c—Eponides umbonatus (Reuss), ×70; *a*, ventral view; *b*, dorsal view; *c*, apertural view. (p. 316)
6a–c—Siphonina jacksonensis Cushman and Applin, ×50; *a*, ventral view; *b*, dorsal view; *c*, apertural view. (p. 316)
7a, b—Siphonina tenuicarinata Cushman, ×60; *a*, ventral view; *b*, dorsal view. (p. 316)
8a, b—Ceratobulimina alazanensis Cushman and Harris, ×40; *a*, dorsal view; *b*, ventral view. (p. 317)
9a, b—Pulvinulinella culter mexicana Cole, ×40; *a*, dorsal view; *b*, ventral view. (p. 317)
10a, b—Eponides byramensis (Cushman), ×50; *a*, ventral view; *b*, dorsal view. (p. 316)

Family BULIMINIDAE
Genus BULIMINA d'Orbigny, 1826
BULIMINA AFFINIS d'Orbigny
Plate 46, figure 9

Bulimina affinis d'Orbigny, 1839 (1840), in De La Sagra's Hist. Phys., Pol. et Nat. de l'Ilede, Cuba, Foraminifères, p. 105, pl. 2, figs. 25, 26. —Coryell and Rivero, 1940, Jour. Paleontology, vol. 14, p. 341, pl. 44, fig. 21.

Specimens of this species are rare in the Carapita formation.

BULIMINA BLECKERI Hedberg
Plate 46, figure 14

Bulimina bleckeri Hedberg, 1937, Jour. Paleontology, vol. 11, p. 675, pl. 91, figs. 12, 13.

Specimens of this species show a striking resemblance to *B. inflata mexicana* Cushman. It may be that they are synonymous.

BULIMINA INFLATA Seguenza
Plate 46, figure 13

Bulimina inflata Seguenza, 1862, Accad. gioenia sci. nat. Atti, 2nd ser., vol. 18, pl. 1, fig. 10.—Cushman, 1922, U. S. Nat. Mus. Bull. 104, pt. 3, p. 93, pl. 21, fig. 1.

BULIMINA SCULPTILIS Cushman
Plate 45, figure 15

Bulimina sculptilis Cushman, 1923, U. S. Geol. Survey Prof. Paper 133, p. 23, pl. 3, fig. 3.—Howe, 1928, Jour. Paleontology, vol. 2, p. 176. —Cole and Ponton, 1930, Florida Geol., Survey Bull. 5, p. 38, pl. 9, fig. 11.—D. K. Palmer and Bermúdez, 1936, Soc. cubana hist. nat. Mem., vol. 10, p. 286.—Cushman and Parker, 1937, Cushman Lab. Foram. Res. Contr., vol. 13, p. 37, pl. 4, figs. 3a–c.

Genus GLOBOBULIMINA Cushman, 1927
GLOBOBULIMINA PACIFICA Cushman
Plate 46, figure 19

Globobulimina pacifica Cushman, 1927, Cushman Lab. Foram. Res. Contr., vol. 3, p. 67, pl. 14, fig. 12.
Globobulimina cf. *G. pacifica* Hedberg, 1937, Jour. Paleontology, vol. 11, p. 676.

This species is widespread in distribution throughout the Tertiary of the Caribbean region and California, as well as in Recent seas.

Genus BOLIVINA d'Orbigny, 1839
BOLIVINA ALAZANENSIS Cushman
Plate 46, figure 26

Bolivina alazanensis Cushman, 1926, Cushman Lab. Foram. Res. Contr., vol. 1, p. 82, pl. 12, fig. 1.—Cushman, 1927, Jour. Paleontology, vol. 1, p. 162, pl. 25, fig. 1.—Nuttall, 1932, Jour. Paleontology, vol. 6, p. 20.—D. K. Palmer and Bermúdez, 1936, Soc. cubana hist. nat. Mem., vol. 10, p. 290.
Bolivina alazanensis venezuelana Hedberg, 1937, Jour. Paleontology, vol. 11, p. 676, pl. 91, figs. 14, 15.

This species is a common and characteristic form in the Carapita formation.

BOLIVINA CARAPITANA Hedberg
Plate 46, figure 25

Bolivina aenariensis carapitana Hedberg, 1937 Jour. Paleontology, vol. 11, p. 676, pl. 91, fig. 16.

Test small, elongate, narrow, slightly compressed; periphery subacute, not keeled, lobate; chambers gently inflated; sutures distinct, depressed; initial end acute; early portion of test with prominent costae; surface punctuate.

Dimensions: Length, 0.38 mm., breadth, 0.15 mm.

This species appears to be distinct. In the opinion of the author it should not be included as a varietal form of *B. aenariensis* from which it differs in being larger, more constricted at the initial end, and in having fewer costae.

Genus UVIGERINA d'Orbigny, 1826
UVIGERINA BYRAMENSIS Cushman
Plate 46, figure 16

Uvigerina byramensis Cushman, 1922, U. S. Geol. Survey Prof. Paper 129, pp. 95, 133, pl. 18, fig. 5.—Cushman, 1923, Prof. Paper 133, p. 34, pl. 4, figs. 10, 11.

Specimens of this species occur only rarely in the Carapita formation.

UVIGERINA CANARIENSIS
NUTTALLIANA Franklin n. var.
Plate 46, figure 22

Uvigerina canariensis, Nuttall, 1932, Jour. Paleontology, vol. 6, p. 22, pl. 5, fig. 9.—D. K. Palmer and Bermúdez, 1936, Soc. cubana hist. nat. Mem., vol. 10, p. 291.
Uvigerina carapitana Hedberg, 1937, Jour. Paleontology, vol. 11, p. 677, pl. 91, fig. 20.

Test short, stout; initial end slightly rounded; walls smooth or with very fine longitudinal striae; aperture set in a slight depression, with a cylindrical neck.

Dimensions: length, 0.38 mm., breadth, 0.18 mm.

Specimens of this species from the Alazan formation show considerable variation in shape. However, it does not appear to be distinct as suggested by Hedberg (1937).

UVIGERINA GARDNERAE NUTTALLIANA Howe and Wallace
Plate 46, figure 15

Uvigerina gardnerae, Nuttall, 1932, Jour. Paleontology, vol. 6, p. 22, pl. 5, fig. 11.
Uvigerina gardnerae nuttalliana Howe and Wallace, 1932, Louisiana Dept. Cons. Geol. Bull. 2, p. 64.

Test elongate, slender; chambers numerous, inflated, the earlier ones overhang those preceding; walls ornamented with longitudinal costae, which are not continuous from one chamber to the next; apertural end with tapering cylindrical neck and lip.

Dimensions: Length, 0.79 mm.; breadth, 0.32 mm.

The varietal form differs from the typical form in that the test is larger, the costae are much coarser, and the spinose character is not developed.

UVIGERINA JACKSONENSIS Cushman
Plate 46, figure 17

Uvigerina jacksonensis Cushman, 1925, Cushman Lab. Foram. Res. Contr., vol. 1, p. 67, pl. 10, fig. 13.—Cushman, 1927, Jour. Paleontology, vol. 1, p. 163, pl. 25, fig. 3.—Howe and Wallace, 1932, Louisiana Dept. Cons. Geol. Bull. 2, p. 65, pl. 12, figs. 7, 8.—Cushman, 1935, U. S. Geol. Survey Prof. Paper 181, p. 40, pl. 16, figs. 1–3.—Cushman, 1937, Cushman Lab. Foram. Res. Contr., vol. 13, p. 81, pl. 12, figs. 4, 5.

UVIGERINA MEXICANA Nuttall
Plate 46, figure 21

Uvigerina mexicana Nuttall, 1932, Jour. Paleontology, vol. 6, p. 22, pl. 5, fig. 9.—D. K. Palmer and Bermúdez, 1936, Soc. cubana hist. nat. Mem., vol. 10, p. 291.

The species from the Carapita formation appear to be identical with the form recorded from the Alazan formation.

UVIGERINA PYGMAEA d'Orbigny
Plate 46, figure 20

Uvigerina pygmaea d'Orbigny, 1826, Annales sci. nat., vol. 7, p. 269, pl. 12, figs. 8, 9.
Uvigerina pygmaea capayana Hedberg, 1937, Jour. Paleontology, vol. 11, p. 677, pl. 91, fig. 19.

Specimens of this well-known species are rare in the Carapita formation.

FAMILY ELLIPSOIDINIDAE
Genus ELLIPSONODOSARIA A. Silvestri, 1900
ELLIPSONODOSARIA VERNEUILI (d'Orbigny)
Plate 46, figure 11

Dentalina verneuili d'Orbigny, 1846, Foram. Foss. Bass. Tert. Vienne, p. 48, pl. 2, figs. 7, 8.
Nodosaria crassielegans Nuttall, 1928, Geol. Soc. London Quart. Jour., vol. 84, p. 80, pl. 4, figs. 6, 7.
Nodosaria verneuili, Nuttall, 1928, Geol. Soc. London Quart. Jour., vol. 84, p. 81, pl. 4, figs. 14, 15.
Nodosarella camerani, Galloway and Morrey, 1929, Bull. Am. Paleontology, vol. 15, no. 55, p. 41, pl. 6, figs. 9–11.
Nodosarella verneuili, Coryell and Rivero, 1940, Jour. Paleontology, vol. 14, p. 344, pl. 42, figs. 18–20, 26.

This distinctive species is widely distributed in the Tertiary of the Caribbean region. It is a common form in the Carapita formation.

Family ROTALIIDAE
Genus VALVULINERIA Cushman, 1926
VALVULINERIA VENEZUELANA Hedberg
Plate 46, figures 24a, b

Valvulineria venezuelana Hedberg, 1937, Jour. Paleontology, vol. 11, p. 678, pl. 91, figs. 21a–c.

The following description is from Hedberg:

Test trochoid; deeply umbilicate on ventral side. About 1 to 1½ whorls visible on dorsal side. Periphery subacute in early chambers of last whorl but becoming broadly rounded and somewhat lobate in last chambers. The last whorl consists of 7 or 8 chambers, rapidly increasing in size. The final chamber occupies about a quarter of the circumference of the test and is usually separated from the penultimate chamber by a marked depression. Sutures distinct, gently curved, variably limbate; frequently raised toward the umbilicus. Wall smooth, thick, perforate, aperture covered by a heavy flap extending well into the umbilicus.

Dimensions: Diameter, 0.70 mm.; thickness, 0.28 mm.

Genus GYROIDINA d'Orbigny, 1826
GYROIDINA aff. G. SOLDANII d'Orbigny
Plate 47, figures la-c

Gyroidina soldanii d'Orbigny, 1826, Annales sci. nat., vol. 7, p. 278, no. 5; Modéle no. 36.
Rotalia soldanii, Brady, 1884, Rept. Voy. Challenger, Zool., vol. 9, p. 706, pl. 107, figs. 6, 7.

Several specimens are tentatively assigned to this species. They show an affinity for the sharp bordered, narrow chambered form observed in the Alazan formation.

Genus EPONIDES Montfort, 1808
EPONIDES BYRAMENSIS (Cushman)
Plate 47, figures 10a, b

Pulvinulina byramensis Cushman, 1922, U. S. Geol. Survey Prof. Paper 129-E, p. 99, pl. 22, figs. 4, 5.
Eponides byramensis, Howe, 1928, Jour. Paleontology, vol. 2, p. 174.—Cole and Gillespie, 1930, Bull. Am. Paleontology, vol. 15, no. 57B, p. 12, pl. 2, figs. 1, 2.—Cole and Ponton, 1930, Florida Geol. Survey Bull. 5, p. 41, pl. 8, figs. 5, 6.—Nuttall, 1932, Jour. Paleontology, vol. 6, p. 26.—Hedberg, 1937, Jour. Paleontology, vol. 11, p. 679, pl. 92, figs. 2a, b.

Specimens of this species are common in the Carapita formation.

EPONIDES CREBBSI Hedberg
Plate 47, figures 2a, b

Eponides crebbsi Hedberg, 1937, Jour. Paleontology, vol. 11, p. 679, pl. 92, figs. 1a–c.

This description of the species is taken from Hedberg:

Ventral side convex; dorsal side slightly convex. About three whorls visible on dorsal side; 10–13 chambers in last whorl. Periphery subacute with a narrow border of glassy shell material. Chambers gradually increasing in size. Sutures clear, very sinuous on ventral side and tangential to the periphery of the preceding whorl. Wall distinctly perforate. Aperture a low opening at the base of the last chamber between the periphery and the umbo.

Dimensions: Diameter, 0.34 mm.; thickness, 0.20 mm.

This species is a distinctive form of the Carapita formation. The sinuous character of the sutures is a dominant feature.

EPONIDES UMBONATUS (Reuss)
Plate 47, figures 5a-c

Rotalina umbonata Reuss, 1851, Deutsche geol. Gesell. Zeitschr., vol. 3, p. 75, pl. 5, fig. 35.
Pulvinulina umbonata, Hantken, 1875 (1876), Magyr. kir. földt. int. Evkön., vol. 4, p. 67, pl. 9, fig. 8.
Rotalia umbonata Galloway and Morrey, 1929, Bull. Am. Paleontology, vol. 15, no. 55, p. 26, pl. 4, figs. 1a–c.
Rotalia ecuadorensis Galloway and Morrey, 1929, idem, vol. 15, no. 55, p. 26, pl. 3, figs. 13a–c.
Eponides umbonata, Cushman, 1929, Cushman Lab. Foram. Res. Contr., vol. 5, p. 98, pl. 14, figs. 8a–c.
Eponides umbonatus ecuadorensis, Hedberg, 1937, Jour. Paleontology, vol. 11, p. 679, pl. 91, fig. 22.

Genus SIPHONINA Reuss, 1850
SIPHONINA JACKSONENSIS Cushman and Applin
Plate 47, figures 6a-c

Siphonina jacksonensis Cushman and Applin, 1926, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 180, pl. 9, figs. 20–23.—Ellisor, 1933, idem, vol. 17, p. 11, pl. 3, fig. 21.—Cushman, 1935, U. S. Geol. Survey Prof. Paper 181, p. 48, pl. 20, figs. 2–8.

SIPHONINA TENUICARINATA Cushman
Plates 47, figures 7a-b

Siphonina tenuicarinata Cushman, 1927, Jour. Paleontology, vol. 1, p. 166, pl. 26, figs. 11, 12.—Cushman, 1927, U. S. Nat. Mus. Proc., vol. 72, p. 6, pl. 4, figs. 1a–c.—Cole, 1927, Bull. Am. Paleontology, vol. 14, no. 51, p. 30, pl. 5, figs. 1, 2.—Cushman, 1929, Cushman Lab. Foram. Res. Contr., vol. 5, p. 100, pl. 14, fig. 9.—Nuttall, 1932, Jour. Paleontology, vol. 6, no. 26.—D. K. Palmer and Bermúdez, 1936, Soc. cubana hist. nat. Mem., vol. 10, p. 304.—Hedberg, 1937, Jour. Paleontology, vol. 11, p. 679, pl. 92, figs. 4a, b.

Genus CANCRIS Montfort, 1808
CANCRIS NUTTALLI (D. K. Palmer and Bermúdez)
Plate 47, figures 3a-c

Cancris sagra Nuttall (not d'Orbigny), 1932, Jour. Paleontology, vol. 6, p. 27, pl. 6, figs. 6, 7.
Valvulineria nuttalli D. K. Palmer and Bermúdez, 1936, Soc. cubana hist. nat. Mem., vol. 10, p. 300, pl. 19, figs. 3–5.

Test longer than broad, biconvex, the ventral side more convex than the dorsal; chambers numerous, all can be seen from the dorsal side, about 6 appear on the ventral side increasing in size until the last-formed chamber comprises about one third of the test; sutures on the dorsal side gently curved, not depressed, on the ventral side radial, only slightly depressed near the umbilicus; periphery subacute, not keeled; aperture opening into umbilicus at the inner margin of the last-formed chamber on the ventral side, covered with a thin lip, wall smooth, slightly perforate.

Dimensions: Length, 0.85 mm.; thickness, 0.35 mm.

This species differs specifically from the form figured from the Mexican Oligocene as *C. sagra* d'Orbigny in lacking the prominent keel characteristic of that form. It differs from *C. auriculus* (Fichtel and Moll) in the general shape of the chambers.

Family CASSIDULINIDAE

Genus CERATOBULIMINA Toula, 1915

CERATOBULIMINA ALAZANENSIS Cushman and Harris

Plate 47, figures 8a, b

Ceratobulimina alazanensis Cushman and Harris, 1927, Cushman Lab. Foram. Res. Contr., vol. 3, p. 174, pl. 29, figs. 5a–c; pl. 30, figs. 3–5.—Nuttall, 1932, Jour. Paleontology, vol. 6, p. 27.

This species is well developed in the Carapita formation.

Genus PULVINULINELLA Cushman, 1926

PULVINULINELLA CULTER MEXICANA Cole

Plate 47, figures 9a, b

Pulvinulinella culter Cushman, 1927, Jour. Paleontology, vol. 1, p. 167, pl. 26, figs. 8, 9.—Cushman, 1929, Cushman Lab. Foram. Res. Contr., vol. 15, p. 100, pl. 14, figs. 13a–c.

Pulvinulinella culter mexicana Cole, 1927, Bull. Am. Paleontology, vol. 14, no. 51, p. 31, pl. 1, fig. 15, 16.—Cole, 1928, idem, vol. 14, no. 53, p. 15.—Nuttall, 1930, Jour. Paleontology, vol. 4, p. 293.—Nuttall, 1932, idem, vol. 6, p. 27.—D. K. Palmer and Bermúdez, 1936, Soc. cubana hist. nat. Mem., vol. 10, p. 304.

Genus CASSIDULINA d'Orbigny, 1826

CASSIDULINA CARAPITANA Hedberg

Plate 47, figures 4a, b

Cassidulina carapitana Hedberg, 1937, Jour. Paleontology, vol. 11, p. 680, pl. 92, figs. 6a, b.

There is some question whether this species is distinct. It shows a striking resemblance to *C. laevigata carinata* Cushman and perhaps should be included in that group.

CASSIDULINA SUBGLOBOSA H. B. Brady

Plate 48, figure 1

Cassidulina subglobosa Brady, 1881, Royal Micr. Soc. Jour., new ser., vol. 21, p. 60.—Brady, 1884, Rept. Voy. Challenger, Zool., vol. 9, p. 430, pl. 54, figs. 17a–c.—Cushman, 1919, Carnegie Inst. Washington Pub. 291, p. 35.—Nuttall, 1928, Geol. Soc. London Quart. Jour., vol. 84, p. 78.—Galloway and Morrey, 1929, Bull. Am. Paleontology, vol. 15, no. 55, p. 40. pl. 6, fig. 6.—Cushman, 1929, Cushman Lab. Foram. Res. Contr., vol. 5, p. 100, pl. 14, figs. 11a, b.—Nuttall, 1932, Jour. Paleontology, vol. 6, p. 28.—D. K. Palmer and Bermúdez, 1936, Soc. cubana hist. nat. Mem., vol. 10, p. 306.—Hedberg, 1937, Jour. Paleontology, vol. 11, p. 680, pl. 92, fig. 5.

The species from the Carapita formation is identical with forms described from Recent oceans and the early Tertiary of the Caribbean region.

Family CHILOSTOMELLIDAE

Genus CHILOSTOMELLA Reuss, 1850

CHILOSTOMELLA OOLINA Schwager

Plate 48, figure 2

Chilostomella oolina Schwager, 1878, Com. geol. ital. Boll., vol. 9, p. 527, pl. 1, fig. 16.—Cushman, 1926, Cushman Lab. Foram. Res. Contr., vol. 1, p. 74, pl. 11, figs. 3–10.—Cushman, 1927, Scripps Inst. Oceanography Bull., Tech. ser., vol. 1, p. 169.—Cushman, 1930, Florida Geol. Survey Bull. 4, p. 59.—Cushman and Moyer, 1930, Cushman Lab. Foram. Res. Contr., vol. 6, p. 61, pl. 8, fig. 15.—Cushman and Cahill, 1933, U. S. Geol. Survey Prof. Paper 175-A, p. 33.—Hedberg, 1937, Jour. Paleontology, vol. 11, p. 680, pl. 92, fig. 3.

Genus SPHAEROIDINA d'Orbigny, 1826

SPHAEROIDINA VARIABILIS Reuss

Plate 48, figure 3

Sphaeroidina variabilis Reuss, 1851, Deutsche geol. Gesell. Zeitschr., vol. 3, p. 88, pl. 7, figs. 61–64.—Cushman, 1929, Cushman Lab. Foram. Res. Contr., vol. 5, p. 101, pl. 14, figs. 15a–c.—Hedberg, 1937, Jour. Paleontology, vol. 11, p. 681, pl. 92, fig. 9.

Sphaeroidina bulloides, Nuttall, 1932, Jour. Paleontology, vol. 6, p. 29.—D. K. Palmer and Bermúdez, 1936, soc. cubana hist. nat. Mem., vol. 10, p. 309.

Specimens of this species are common in the Carapita formation.

Family GLOBIGERINIDAE

Genus GLOBIGERINA d'Orbigny, 1826

GLOBIGERINA BULLOIDES d'Orbigny

Plate 48, figure 4

Globigerina bulloides d'Orbigny, 1826, Annales Sci. Nat., vol. 7, p. 277, no. 1; Modèles, no. 17 and 76.

This well-known species occurs frequently in the Carapita formation.

GLOBIGERINA CONCINNA Reuss

Plate 48, figure 5

Globigerina concinna Reuss, 1850, Deutsch. K. Akad. Wiss. Wien, vol. 1, p. 373, pl. 47, fig. 8.—Galloway and Wissler, 1927, Jour. Paleontology, vol. 1, p. 41, pl. 7, fig. 7.—Nuttall, 1932, Jour. Paleontology, vol. 6, p. 29, pl. 6, figs. 9–11.

Test subcircular in outline; chambers numerous, about ten in number, distinct, globular, arranged in an elevated spire; sutures distinct, depressed; wall reticulate; aperture a large circular opening into umbilicus.

Dimensions: Diameter, 0.35 mm.

Specimens of this species occur only rarely in the Carapita formation.

Genus GLOBIGERINELLA Cushman, 1927

GLOBIGERINELLA cf. G. AEQUILATERALIS (H. B. Brady)

Plate 48, figure 6

Globigerina aequilateralis H. B. Brady, 1879, Quart. Jour. Micr. Soc., vol. 19, p. 71.—H. B. Brady, 1884, Rept. Voy. Challenger, Zool., vol. 9, p. 605, pl. 80, figs. 18–21.

Globigerinella aequilateralis, Cushman, 1924, U. S. Nat. Mus. Bull. 104, pt. 5, p. 25, pl. 4, figs. 7, 8.—Cushman, 1927, Bull. Scripps Inst. Oceanography, Tech. ser., vol. 1, p. 174.

Several specimens are tentatively assigned to this species.

Family GLOBOROTALIIDAE

Genus GLOBOROTALIA Cushman, 1927

GLOBOROTALIA SPINULOSA Cushman

Plate 48, figure 8

Globorotalia spinulosa Cushman, 1927, Cushman Lab. Foram. Res. Contr., vol. 3, p. 114, pl. 23, figs. 4a–c.—Cole, 1927, Bull. Am. Paleontology, vol. 14, no. 51, p. 34, pl. 2, fig. 9.—Nuttall, 1930, Jour. Paleontology, vol. 4, p. 288.—Howe, 1939, Louisiana Dept. Cons. Geol. Bull. 14, p. 85, pl. 12, figs. 10–12.

This species is known from the Eocene of Louisiana, and the Eocene and Oligocene of Mexico. It is rare in the Carapita formation.

Family ANOMALINIDAE

Genus ANOMALINA d'Orbigny, 1826

ANOMALINA ALAZANENSIS Nuttall

Plate 48, figure 9

Anomalina alazanensis Nuttall, 1932, Jour. Paleontology, vol. 6, p. 31, pl. 8, figs. 5–7.—D. K. Palmer and Bermúdez, 1936, Soc. cubana hist. nat. Mem., vol. 10, p. 311, pl. 19, figs. 11–13.

Test planoconvex; periphery rounded; sutures gently curved, limbate; wall coarsely perforate; aperture a narrow slit, peripheral.

Dimensions: Diameter, 0.68 mm.

Specimens from the Carapita formation were found to be identical with specimens from the Oligocene of Mexico and Cuba.

ANOMALINA JACKSONENSIS TEXANA (Cushman and Applin)

Plate 48, figures 11a, b

Discorbis jacksonensis texana Cushman and Applin, 1926, Am. Assoc. Petroleum Geologists Bull., vol. 10, p. 178, pl. 9, fig. 11.

Anomalina jacksonensis texana, Howe and Wallace, 1932, Louisiana Dept. Cons., Geol. Bull. 2, p. 77, pl. 14, figs. 3a–c.—Ellisor, 1933, Am. Assoc. Petroleum Geologists Bull., vol. 17, no. 11, pl. 4, fig. 8.

This is the first record of this species from a horizon younger than the Eocene.

ANOMALINA MECATEPECENSIS Nuttall

Plate 48, figures 7a, b

Anomalina mecatepecensis Nuttall, 1932, Jour. Paleontology, vol. 6, p. 30, pl. 7, figs. 4, 6.—Hedberg, 1937, Jour. Paleontology, vol. 11, p. 682, pl. 92, figs. 10a, b.

This species occurs only rarely in the Carapita formation.

ANOMALINA NOLANI Hedberg

Plate 48, figures 10a, b

Anomalina nolani Hedberg, 1937, Jour. Paleontology, vol. 11, p. 681, pl. 92, figs. 11a–c.

Superficially the species resembles *A. alazanensis* Nuttall, but in detail it appears to be distinct.

EXPLANATION OF PLATE 48

FIGS. *1*—*Cassidulina subglobosa* H. B. Brady, ×180. (p. 317)

2—*Chilostomella oolina* Schwager, ×50. (p. 317)

3—*Sphaeroidina variabilis* Reuss, ×90. (p. 317)

4—*Globigerina bulloides* d'Orbigny, ×100. (p. 317)

5—*Globigerina concinna* Reuss, ×70. (p. 317)

6—*Globigerinella* cf. *G. aequilateralis* (H. B. Brady), ×40. (p. 318)

7a, b—*Anomalina mecatepecensis* Nuttall, ×50; *a*, dorsal view; *b*, ventral view. (p. 318)

8—*Globorotalia spinulosa* Cushman, ×60. (p. 318)

9—*Anomalina alazanensis* Nuttall, ×40. (p. 318)

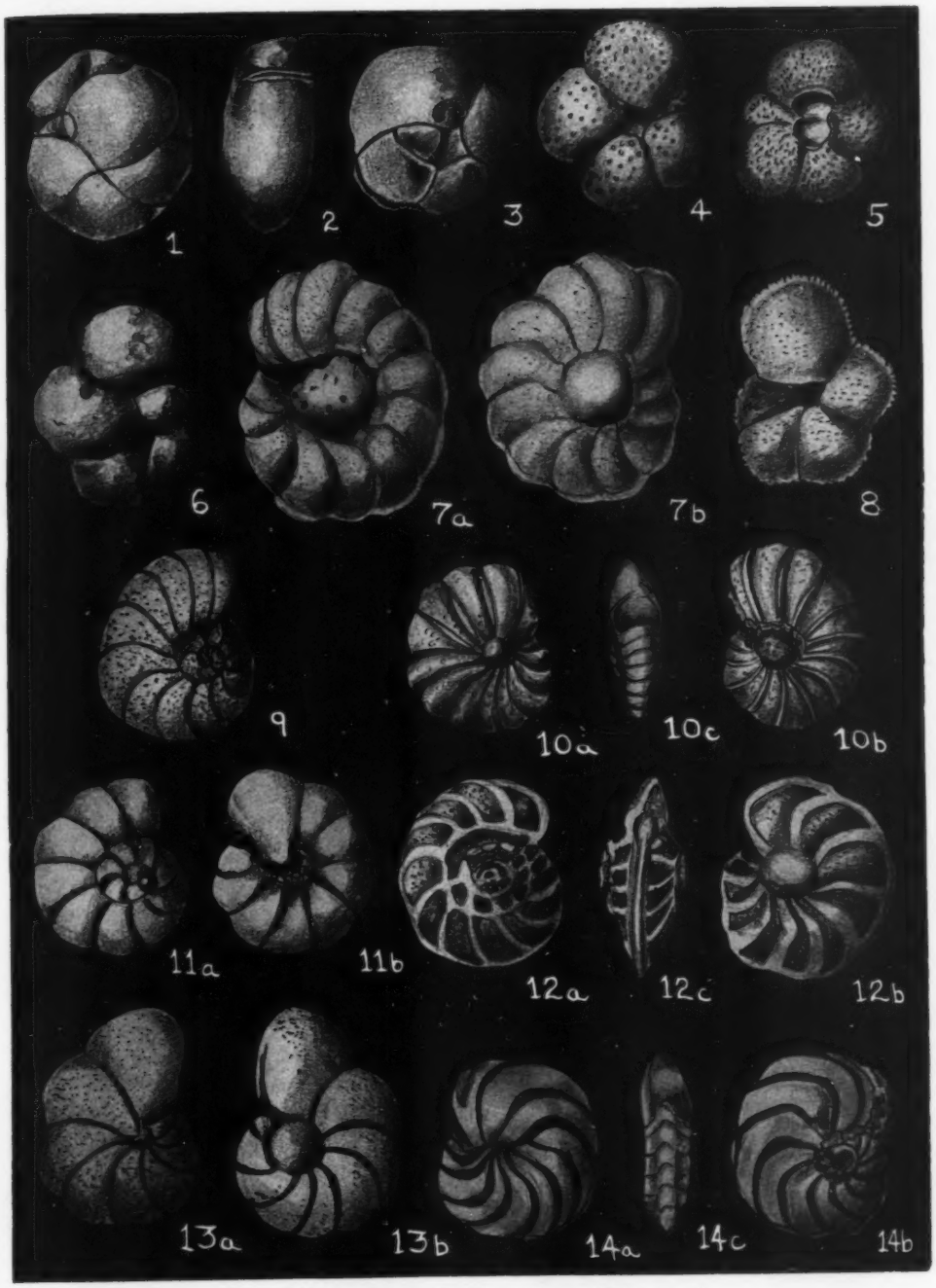
10a–c—*Anomalina nolani* Hedberg, ×50; *a*, ventral view; *b*, dorsal view; *c*, peripheral view. (p. 318)

11a, b—*Anomalina jacksonensis texana* (Cushman and Applin), ×40; *a*, dorsal view; *b*, ventral view. (p. 318)

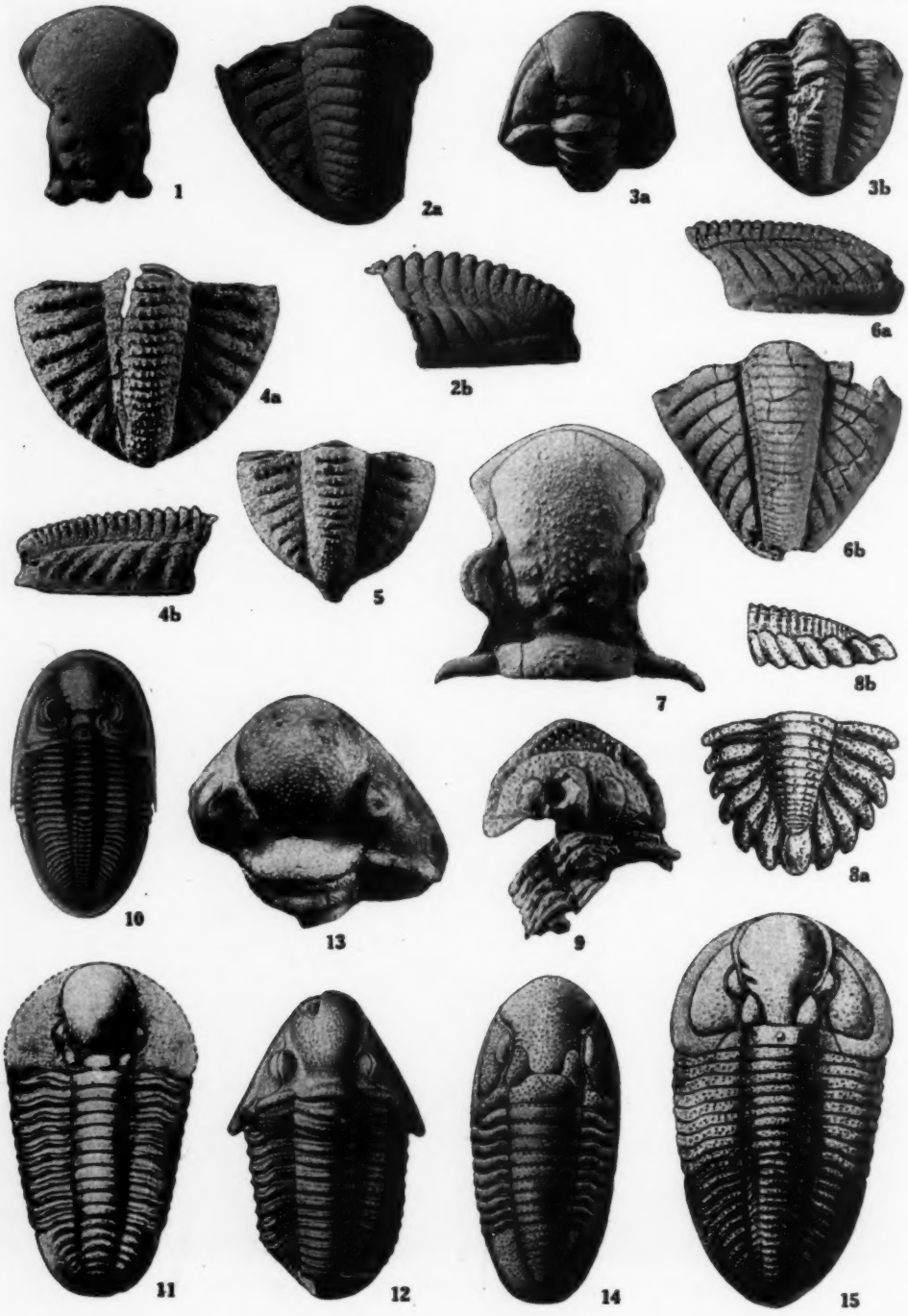
12a–c—*Anomalina pariana* Hedberg, ×60; *a*, dorsal view; *b*, ventral view; *c*, peripheral view. (p. 319)

13a, b—*Cibicides americanus* (Cushman), ×40; *a*, ventral view; *b*, dorsal view. (p. 319)

14a–c—*Cibicides mantaensis* (Galloway and Morrey), ×70; *a*, ventral view; *b*, dorsal view; *c*, peripheral view. (p. 319)



Franklin—Foraminifera from Venezuela



Weller—Permian trilobites

ANOMALINA PARIANA Hedberg
Plate 48, figures 12a–c

Anomalina pariana Hedberg, 1937, Jour. Paleontology, vol. 11, p. 681, pl. 92, figs. 8a–c.

This species is a characteristic form of the Carapita formation. It is fairly abundant.

Genus CIBICIDES Montfort, 1808
CIBICIDES AMERICANUS (Cushman)
Plate 48, figures 13a, b

Truncatulina americana Cushman, 1918, U. S. Geol. Survey Bull. 676, p. 63, pl. 20, figs. 2, 3; pl. 21, fig. 21.—Cushman, 1918, U. S. Nat. Mus. Bull. 103, p. 68, pl. 23, figs. 2a–c.—Cushman, 1920, U. S. Geol. Survey Prof. Paper 128, p. 70, pl. 11, fig. 10.—Cushman, 1922, Prof. Paper 129-E, p. 97, pl. 20, figs. 7, 8.

Cibicides americana, Howe, 1928, Jour. Paleontology, vol. 2, p. 174.—Nuttall, 1928, Jour. Paleontology, vol. 2, p. 372.—Cushman, 1930, Florida Geol. Survey Bull. 4, p. 61, pl. 12, figs. 5a–c.—Nuttall, 1932, Jour. Paleontology, vol. 6, p. 32, pl. 7, figs. 10, 11.

Cibicides americanus, Cole and Gillespie, 1930, Bull. Am. Paleontology, vol. 15, no. 57B, p. 14, pl. 14, fig. 4.—Hedberg, 1937, Jour. Paleontology, vol. 11, p. 682.

Test planoconvex; chambers numerous, 8 to 10 in the last whorl; sutures gently curved, slightly limbate; periphery subacute; wall finely perforate; aperture peripheral with slight lip.

Dimensions: Diameter, 0.70 mm.

This species is probably not as widespread as the records seem to suggest. The specific limits of the form have been variously interpreted by authors as is evidenced by the variations in published illustrations.

CIBICIDES MANTAENSIS (Galloway and Morrey)
Plate 48, figures 14a–c

Anomalina mantaensis Galloway and Morrey, 1929, Bull. Am. Paleontology, vol. 15, no. 55, p. 28, pl. 4, figs. 5a–c.

Cibicides mantaensis, Hedberg, 1937, Jour. Paleontology, vol. 11, p. 683, pl. 92, figs. 12a–c.

The species from the Carapita formation agrees closely with the form figured by Galloway and Morrey from Ecuador.

EXPLANATION OF PLATE 49
PERMIAN TRILOBITE GENERA

FIGS. *1–2b—Delaria antiqua. 1*, Cranidium without neck-ring and palpebral lobes, ×4, U.S.G.S. No. 7043, Bone Spring limestone, 3 miles south of Guadalupe Point, Culberson County, Texas. *2a, b*. One of Girty's syntypes, here designated holotype, ×4, U.S.G.S. No. 1178, Bone Spring limestone, 2 miles south of El Capitan, Culberson County, Texas. (p. 321)

3a, b—Ditomopyge decurtata. Holotype ×2, University of Amsterdam collection, Lower Permian, near Wichita, Kansas. (p. 320)

4a–5—Vidria vespa n. sp. *4a, b*, Holotype ×2. *5*, An immature pygidium ×4, U. S. Nat. Mus. collection, first (lowest) limestone of Word formation, ¼ mile south of Word Ranch, 17 miles north-northeast of Marathon, Texas. (p. 323)

6a–7—Anisopyge perannulata. 6a, b. One of Girty's syntypes, here designated holotype ×4, U.S.G.S. collection, "dark limestone," lower Capitan limestone, Pine Spring, Culberson County, Texas. *7*, Cranidium ×4, U.S.G.S. No. 7062, Carlsbad limestone, north rim of Pine Spring Canyon, Culberson County, Texas. (p. 321)

8a, b—Cheiropyge himalayensis. Holotype ×2 after Diener. (p. 322)

9—Cheiropyge kansasensis, n. sp. Holotype ×4. Illinois Geol. Surv. No. 3497, top of Haskell limestone, Levenworth County, Kansas, 15 miles north of Lawrence. (p. 322)

10—Pseudophillipsia sumatrensis. Holotype ×1, after Roemer. (p. 324)

11—Permoproetus teschi. Reconstruction, ×2, after Toumansky. (p. 326)

12, 13—Neoproetus indicus. 12, Holotype ×1 after Tesch; *13*, Caphalon ×1½, after Gheyselinck. (p. 325)

14—Paraphillipsia karpinskyi. Reconstruction ×2, after Toumansky. (p. 326)

15—Neogriffithides gemmellaroi Reconstruction ×2, after Toumansky. (p. 325)

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PERMIAN TRILOBITE GENERA

J. MARVIN WELLER[1]

ABSTRACT—Eight genera and subgenera of Permian trilobites have been proposed. Two were based on American species and one of these is referred to the synonymy of *Ditomopyge*. Representatives of only two foreign genera have been tentatively recognized in America. Two new American genera are proposed. The nine exclusively Permian genera are diagnosed and two new species are described.

INTRODUCTION

EIGHT NAMES have been proposed for genera or subgenera of Permian trilobites as follows:

Pseudophillipsia Gemmellaro, 1892
Cheiropyge Diener, 1897
Anisopyge Girty, 1908
Neoproetus Tesch, 1923
Neogriffithides Toumansky, 1935
Paraphillipsia Toumansky, 1935
Permoproetus Toumansky, 1935
Neophillipsia Gheyselinck, 1937

The validity of the generic or subgeneric groups to which some of these names may be applied has been variously questioned or denied, and some authors have considered these names to be synonyms of one another or of the older genera *Brachymetopus*, *Phillipsia* and *Griffithides*. This situation is partly the result of incomplete or imperfect descriptions by the authors of these names or by the authors of their type species. Probably more important, however, has been the unsatisfactory system of classification into which most Carboniferous trilobites have been forced to fit and the poor understanding of what characters possessed by these organisms are of practical value for purposes of classification.

Although the significant characters of some of these groups may be understood only more or less incompletely from published descriptions and figures, all appear to be distinct and worthy of full generic standing.

In addition to the genera listed above, Permian species have been assigned erroneously to the Silurian and Devonian genus *Proetus* Steininger, 1831 and the Mississippian genera *Brachymetopus* McCoy, 1847, *Phillipsia* Portlock, 1843, and *Griffithides* Portlock, 1843. Mississippian and Pennsylvanian genera which range into the Lower Permian are *Paladin* Weller, 1936, *Kaskia* Weller, 1936, *Ditomopyge* Newell, 1931, and *Ameura* Weller, 1936. Finally, two new genera have been distinguished as a result of recent studies of American Permian trilobites.

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Subgenus NEOPHILLIPSIA Gheyselinck

Plate 49, figures 3a, b

Neophillipsia Gheyselinck, 1937, Permian trilobites, Timor and Sicily, p. 56.
Subgenotype: *Phillipsia* (*Neophillipsia*) *decurtata*. Gheyselinck, ibid., p. 56. text fig. 14b, p. 52. Wolfcamp series, Permian of Kansas; monotypic subgenus.

Neophillipsia Gheyselinck 1937 was proposed as a subgenus of *Phillipsia* on the basis of a single specimen described as *Phillipsia* (*Neophillipsia*) *decurtata*. This specimen, which is preserved in the collections of the University of Amsterdam, had been obtained from Ward's Scientific Establishment about twenty years before and was originally labeled "*Phillipsia sangamonensis*, Pennsylvanian, Wichita, Kansas." It was kindly lent to me for study in 1938 by Professor H. A. Brouwer.

This specimen is enrolled and practically complete. It is identical in form and preservation to numerous specimens that I have examined from southern Kansas, particularly from the Florena shale near Grand Summit, Cowley County, and from the Eskridge shale in Greenwood County, which I had already described in manuscript under another name. The species is a perfectly typical representative of the genus *Ditomopyge* and it is one of the last stages in a long evolutionary series whose earliest representatives occur in Lower Pennsylvanian beds. The Florena shale is a member of the Beattie limestone which overlies the Eskridge shale both of the Council Grove group of Lower Permian age. This species has also been obtained from the Hueco and

Wolfcamp formations in Texas and New Mexico and only slightly different pygidia have been collected from the Bone Spring limestone in West Texas. There can be no reasonable doubt that *Ditomopyge decurtata* (Gheyselinck) is a Lower Permian species and the name *Neophillipsia*, like *Cyphinium* Weber 1933, is a junior subjective synonym of *Ditomopyge*.

Genus DELARIA J. M. Weller, n. gen.
Plate 49, figures 1–2a

Genotype: *Anisopyge? antiqua* Girty, 1908. U. S. Geol. Survey Prof. Paper 58, p. 509; Leonard series, Permian of West Texas.

Generic Characters—Cephalon generally without flattened anterior marginal band, much expanded in front. Basal lobes large, basal furrows straight. Preoccipital lobe present between basal lobes. Lateral glabellar furrows not conspicuous, chiefly indicated by intervening swellings on sides of glabella.

Thorax probably with nine segments.

Pygidium more or less narrowly rounded behind, composed of 15 to 18 axial and 7 or 8 pleural segments. Axis generally high, with tendency toward triangular cross section. Flange slightly overturned behind in most species.

Ornamentation consisting of granules or pustules on glabella and fine granules on crest of pygidial axis; some species nearly or quite smooth.

Range—Characteristic of Leonard series, Lower Permian, southwestern United States. Rare in Guadalupe series, Middle Permian of same region.

Remarks—*Delaria* appears to have developed out of *Ditomopyge* to which it is similar in many respects. It may be distinguished by the lateral glabellar swellings, the more uniformly sized and separated pleural segments of the pygidium, and in most species by the more narrowly crested and higher pygidial axis and posteriorly overturned flange.

Genus ANISOPYGE Girty
Plate 49, figures 6a–7

Anisopyge Girty, 1908. U. S. Geol. Survey Prof. Paper 58, p. 505.

Genotype: *Phillipsia perannulata* Shumard, 1858. Acad. Sci. St. Louis Trans., vol. 1, p. 296; Guadalupe series, Permian of New Mexico. Monotypic genus.

Generic Characters—Cephalon with anterior margin not flattened but continuing forward slope of glabella or standing vertically and not visible from above. Glabella expanded in front. Basal lobes very small, swollen. Basal furrows nearly straight. Preoccipital lobe small, well in advance of basal lobes. Lateral glabellar furrows more or less transverse. Glabella may be swollen on either side between lateral furrows. Eyes moderately large. Genal spines very short or absent.

Thorax with nine segments.

Pygidium subtriangular, very narrowly rounded behind. Axis well elevated, composed of 21 to 33 segments, sides flattened, crest arched transversely with furrows gently concave forward. First axial segment overlapped by last thoracic segment except on crest. Pleural segments 8, of equal width and strength. Flange well defined, becoming steeper posteriorly, may be conspicuously overturned beneath termination of axis.

Ornamentation finely granulose.

Range—Guadalupe series of Middle Permian in southwestern United States.

Remarks—This genus has been referred by some authors to the synonymy of *Pseudophillipsia* but it is certainly distinct and may be recognized by the absence of a flat anterior cephalic margin, the small size of the preoccipital lobe that is indistinctly separated from the forward part of the glabella, the lateral glabellar furrows that extend obliquely inward and backward, the peculiar overlapping of first axial segment of the pygidium, and the great discrepancy between number of pygidial pleural and axial segments. This last character is not equalled by any other trilobite.

Girty overemphasized the significance of the posteriorly overturned pygidial flange which does not occur in all species. His remarks concerning the genus and its typical species are likewise inaccurate with respect to the number of thoracic segments (he gave the number as seven) and the absence of fixed cheeks except for the palpebral lobes; although narrow they are distinctly present.

The generic assignment of *Anisopyge inornata* Girty, based on pygidia from the Yeso limestone, is quite uncertain. It may

be an early representative of *Anisopyge* or it may belong to a distinct genus whose other parts are as yet unknown.

Genus CHEIROPYGE Diener
Plate 49, figures 8a, b

Cheiropyge Diener, 1897. Paleontologica Indica ser. 15, vol. 1, pt. 3, p. 4.

Genotype: *Cheiropyge himalayensis* Diener, 1897, p. 5, "Permocarboniferous," Chitichun, Central Himalayas; monotypic genus.

Generic Characters—Cephalon bordered by conspicuous flat marginal band, obtusely pointed, widest anteriorly. Main raised part of cephalon transversely semielliptical, about twice as wide as long. Glabella small, length and width about equal, sides nearly parallel, about half as long as complete cephalon. Basal lobes not prominent, lateral glabellar furrows absent. Eyes large, short, about half the size of glabella. Genal angles rounded.

Number of thoracic segments unknown.

Pygidium wider than long, axis well elevated about one-third as wide as pygidium, tapering rapidly backward; crest arched, composed of 15 to 20 segments. Pleural lobes of 6 segments becoming broader posteriorly, separated by deep furrows. Another rib similar to pleural segments but slightly wider extends backward from axial termination. Flange indistinct, each pleural segment continuing to margin where it ends in a rounded projection giving margin a crenulated appearance.

All of cephalon, including marginal band, ornamented with large granules. Crests of pygidial segments likewise granulose.

Range—"Permocarboniferous" of Central Himalayas; Lower Permian of Kansas.

Remarks—This genus was based upon a single pygidium. The foregoing diagnosis of the cephalon is taken from a Kansas specimen which is believed to be congeneric. Both are obviously brachymetopoid and they are the only trilobites of this type known from Permian strata except for a single free cheek figured but not named by Toumansky from the Crimea.

CHEIROPYGE KANSASENSIS
J. M. Weller, n. sp.
Plate 49, figure 9

Material—One imperfect extended specimen.

Description—Cephalon obtusely pointed before, with conspicuous flat marginal band widest in front, genal angles rounded, ratio of breadth to length about 1.7. Main part of cephalon exclusive of marginal band transversely semielliptical, ratio of breadth to length about 2.2. Glabella small, a little longer than wide, sides nearly parallel, extending forward slightly beyond mid-length of cephalon. Neck-ring not preserved. Basal lobes if present poorly preserved, not conspicuous. Lateral glabellar furrows absent. Facial sutures not apparent. Eyes fairly large, short, about half the size of glabella. Palpebral lobes not preserved, probably nearly as high as central part of glabella, arching upward from deep narrow axial furrows. Eyes paralleled at base by narrow rounded shallow furrows. Lateral slopes of cheeks and forward slope of cephalon anterior to glabella moderately steep, separated from flattened marginal rim by rather abrupt change in inclination. Rim wide, particularly in front, upper surface horizontal or sloping gently outward, curving downward abruptly to very narrow outer vertical surface. Ornamentation on glabella and palpebral lobes not preserved. Remainder of cephalon, both sloping portions and flattened rim covered with rather uniformly sized and spaced small granules.

Thorax crushed, displaced, seven thoracic segments discernible, total number probably greater. Axial lobe apparently somewhat wider than glabella. Pleural lobes rather sharply bent downward at about midwidth. All segments ornamented with tiny granules.

Pygidium incompletely preserved, ratio of breadth to length about 1.5. Axis evenly arched transversely, probably slightly less than one-third as wide as entire pygidium anteriorly, tapering rapidly, decreasing uniformly in height and width posteriorly; composed of about 20 segments becoming progressively narrower behind; intersegmental furrows narrow, shallow, continuous from one axial furrow to the other. Pleural lobes flat near axial furrows, curving evenly downward before midwidth to moderately steep outer slopes; composed of 6 segments of uniform width near axial furrows, widening outward, posterior segments becoming progressively a little wider at their extremities, separated by compound furrows equal in width to ribs near axial furrows, not widen-

ing but becoming deeper outward. Compound furrows contain both principal and subsidiary furrows, both narrow and shallow, the former only slightly more deeply impressed, separated by narrow low ridge. Flange wide but indistinct, strongly corrugated by ribs which continue to margin and extend as rounded crenulations, neither principal nor subsidiary furrows distinguishable in deep broadly rounded compound furrow. Axial segments ornamented by closely spaced granules of uniformly small size on both crest and sides. Pleural ribs carry somewhat irregularly spaced and sized larger granules, largest generally located about halfway to margin; continuations of ribs on flange unornamented. Small ridges between principal and subsidiary furrows marked by closely spaced small granules comparable to those on axis.

Occurrence—Top of Haskell limestone (Lower Permian), Levenworth County, about 15 miles north of Lawrence, Kansas.

Remarks—This unique specimen is preserved in weathered ferruginous limestone. The cephalon and part of the crushed thorax is an internal cast. The pygidium and part of the thorax is an external mould broken longitudinally and imperfect posteriorly and along the right margin. It was collected by Dr. M. K. Elias.

Only the pygidial characters of *Cheiropyge* are known, and the pygidium of this new species from Kansas is imperfectly preserved so that its reference to that genus is somewhat uncertain. Both the Himalayan and American specimens, however, are obviously brachymetopoid and no differences can be pointed out that seem to warrant their generic separation. Both possess six segments in their pleural lobes that continue strongly across the flange and end in projections giving the pygidia crenelated outlines. Both differ from *Brachymetopus* in the prominence of their pleural ribs and the relative unimportance of subsidiary furrows. Both possess rapidly tapering pygidial axes composed of narrow segments greatly exceeding the number of pleural segments. The occurrence of a wide rib extending backward from the termination of the axis in *C. kansasensis* similar to that in *C. himalayensis* is inferred but not certainly established.

C. kansasensis differs most obviously from *C. himalayensis* by the greater relative width of its pygidium and larger number of axial segments. The existence of both principal and subsidiary furrows in the wide compound furrows of the latter's pygidium has not been noted. This is the younger species (Middle Permian) and perhaps the individual furrows have become obsolete. Perhaps preservation is not sufficiently perfect for them to be distinguishable.

Genus VIDRIA J. M. Weller, n. gen.

Genotype: *Vidria vespa* J. M. Weller, n. sp.

Generic Characters—Cephalon and thorax unknown. Pygidium semi-oval, broadly rounded behind except for single posterior spine that is prominent on immature specimens but becomes nearly obsolete at maturity. Axis composed of 17 to 19 segments, crest arched transversely. Pleural lobes composed of 7 segments, becoming more prominent outward, ending abruptly in strongly elevated terminations, separated by wide rounded furrows. Flange very narrow at maturity.

Ornamented by granules on axial crest and outer parts of pleural segments.

Range—Known only in lower part of Guadalupe series, Middle Permian, West Texas.

Remarks—Although it is generally inadvisable to erect trilobite genera on the basis of isolated pygidia, the specimens for whose reception this genus is proposed are so distinctive that they cannot be referred to any other recognized genus. No other Permian trilobite is known which possessed a single posterior spine at any stage of its development and this in combination with details of pleural lobation and very narrow flange sharply distinguishes these specimens from the pygidia of all other genera.

VIDRIA VESPA J. M. Weller, n. sp.

Plate 49, figures 4a–5

Material—Two silicified pygidia from a single locality.

Description—Pygidium depressed, semi-oval, evenly rounded behind, ratio of breadth to length about 1.5. Axis less than one-third as wide as pygidium anteriorly, crest well arched, sides flattened, of almost uniform height narrowing regularly backward, ending in rounded slightly overhanging termination, composed of 19 segments separated by

rounded furrows well impressed on crest, on sides much shallower and becoming obsolete behind, first segment narrower than next, last three strongly convex backward. Pleural lobes flat above, curving downward to fairly steep outer slopes beyond midwidth, composed of 7 asymmetrical segments of uniform width and nearly uniform distinctness, becoming progressively higher and more prominent outward from axial furrows, ending abruptly above flange, separated by open broadly rounded furrows. Subsidiary furrows not apparent. Flange very narrow, continues slope from troughs of intersegmental furrows except anteriorly where it is slightly less steeply inclined, posteriorly outer margin rises slightly, forms bluntly angular termination beneath end of axis. Ornamentation consists of longitudinally elongated granules, not arranged in rows, about 6 on the crest of each axial segment and smaller symmetrical granules widely spaced on the outer halves of pleural segments.

Occurrence—First (lowest) limestone of the Word formation, near top of slope about ¼ mile southwest of Word Ranch, 17 miles north-northwest of Marathon, Texas. The specimens were collected and etched from limestone by Dr. G. A. Cooper and are in the collection of the U. S. National Museum.

Remarks—The foregoing description is based upon the larger of the two specimens. The smaller pygidium, believed to be an immature specimen of the same species, is similar in general outline and number of pleural segments but is proportionately higher and possesses 17 instead of 19 axial segments, the last of which are not notably convex backward, a much wider flange and a prominent posterior spine whose acute termination has probably been broken away. The posterior spine, which is almost but not completely lost in the large specimen, is comparable to the two spines on adolescent pygidia of *Ditomopyge* but persists as a conspicuous feature on specimens of much larger size. No other Carboniferous of Permian species is known which has pygidia with which these can possibly be confused.

Genus PSEUDOPHILLIPSIA Gemmellaro
Plate 49, figure 10

Pseudophillipsia Gemmallaro, 1892. Soc. Ital. Sci. Mem. ser. 3, vol. 8, no. 1, p. 14.

Genotype: *Phillipsia sumatrensis* Roemer, 1880, Palaeontographica, vol. 27, p. 10, Permian of Sumatra, by original designation.

Generic Character—Cephalon with flattened marginal band anterior to glabella. Glabella expanded in front. Basal furrows rather strongly curved. Preoccipital lobe small, may be depressed. Lateral glabellar furrows extend obliquely inward and forward. Glabella swollen on either side between lateral furrows. Eyes relatively small.

Thorax with nine segments.

Pygidium elongated, more or less subtriangular. Axis very narrow, strongly elevated, trapezoidal in cross section, composed of 24 to 27 segments. Pleural lobes of 13 to 15 segments. Flange well defined, somewhat flattened.

Ornamentation granulose.

Range—Permian of Sicily, East Indies, Central Himalayas?, China?, California?

Remarks—Phillipsia sumatrensis has never been adequately described, and although Gemmellaro named this species as the genotype of *Pseudophillipsia*, it is obvious that his conception of the genus was based principally upon the study of his own species *P. elegans*. Apparently the most significant differences between these two species are that in the former, the preoccipital lobe is much depressed and practically lost in what seems to be an extraordinarily wide occipital furrow, the termination of the pygidial axis is gently sloping and the furrows on its crest are very gently convex posteriorly, whereas in the latter, the preoccipital lobe, although small as the result of wide furrows before and behind, is strongly elevated, the termination of the pygidial axis overhangs the flange and the intersegmental furrows of its crest are straight. The correspondence of these species, however, in the inward and forward direction of the lateral glabellar furrows and the swellings which separate them and the very narrow thoracic and pygidial axes in addition to other characters mentioned above is convincing evidence that they are congeneric.

Griffithides nosoniensis Wheeler from the Nosoni formation of Shasta County, California, is somewhat doubtfully referred to *Pseudophillipsia*. It is certainly not a typical representative of this genus but the inward and forward direction of the lateral glabellar furrows and flattened crest of the pygidial

axis are more suggestive of *Psdueophillipsia* than of any other recognized genus.

Genus NEOPROETUS Tesch
Plate 49, figures 12, 13

Neoproetus Tesch, 1923, Palaeontologia Timor Lief. 12, pt. 21, p. 130.

Genotype: *Neoproetus indicus* Tesch, ibid., p. 128, Permian of Timor and Letti; monotypic genus.

Generic Characters—Cephalon subtriangular. Glabella inflated, expanding in front, extending to or overhanging vertical anterior margin. Basal lobes of moderate size, not inflated; basal furrows curved, shallow, wide, equal or exceeding in prominence adjacent parts of axial furrows making basal lobes inconspicuous. Lateral glabellar furrows absent. Postero-central portion of glabella between basal lobes more or less depressed. Palpebral lobes wide; anterior parts of fixed cheeks very narrow, not widening forward. Eyes of moderate size, free cheeks steeply sloping.

Thorax with nine segments.

Pygidium evenly rounded behind. Axis wide, arched transversely, composed of 9 or 10 segments. Pleural lobes with 6 or 7 segments. Flange indistinct, separated from main portions of pleural lobes by broad shallow furrow, bearing continuations of pleural segments that become less distinct outward but continue to margin, which may be slightly crenelated.

Ornamented by abundant fine granules and concentric wrinkles, the latter restricted to the forward part of the glabella.

Range—Permian beds of East Indies and Sicily. Also reported from the Crimea and China.

Remarks—Gheyselinck's careful restudy of Tesch's types and other specimens has served to correct certain errors in the original description and figures, and the foregoing summary is based largely upon his remarks. The most important corrections are: Basal lobes are present, the thorax is composed of 9 segments, and a pygidial flange is present but indistinct.

The cephalon of this genus is similar in a general way, except for the forward gibbosity of its glabella, to certain species generally referred to *Griffithides*. It is likewise similar to *Permoproetus* except for the more normal position of the basal lobes. The undulating nature of the pygidial flange serves to differentiate it from all other described Permian genera except *Cheiropyge*.

On the whole, *Neoproetus* presents a rather primitive appearance and there is little in its organization that suggests Permian age.

Genus NEOGRIFFITHIDES Toumansky
Plate 49, figure 15

Neogriffithides Toumasky, 1935. Perm.-Carb. tril. Crimea, p. 13 (41).

Genotype: *Neogriffithides gemmelaroi* Toumansky, ibid, p. 14 (42) by original designation, Middle Permian limestone of Crimea.

Generic Characters—Cephalon broadly semi-oval without flat marginal band anterior to glabella. Glabella expanded in front. Basal lobes large, low; basal furrows curved in front. Lateral furrows in 2 or 3 pairs, short, inclined backward from axial furrows. Fixed cheeks very narrow, not widening notably anteriorly; palpebral lobes very narrow. Free cheeks broad with wide rims; eyes small; genal angles rounded, without spines.

Thorax probably with nine segments.

Pygidium nearly as long as broad. Axis about one third as wide as entire pygidium, high, with arched crest, composed of 17 to 20 segments, termination overhanging. Pleural lobes with 11 to 12 segments, subsidiary furrows present in first few segments. Flange distinct, somewhat flattened.

Ornamentation finely granulose.

Range—Middle Permian of the Crimea and Sicily.

Remarks—The greater part of the fragmentary trilobite material described by Toumansky was collected at a single locality. He recognized 32 species and varieties (only 20 were named) assigned to 8 genera, 3 of which were new. Recognition of the different parts of individual species in such material is exceedingly difficult and any conclusions that may be drawn must be more or less uncertain. *Neogriffithides gemmellaroi*, however, is stated to be the most abundantly represented species, and it seems probable, therefore, that the parts so identified have been correctly associated.

The cranidium of this genus is quite similar to the cranidia of certain Middle Mississippian species that have been commonly referred to *Griffithides* except that the lateral glabellar furrows are more strongly impressed and that the palpebral lobes are

much smaller. The free cheeks, however, appear to be quite distinctive, lacking as they do, any suggestion of genal spines. The only similar free cheeks that have been described were referred by Toumansky, perhaps erroneously, to *Paraphillipsia*. The pygidium of *Neogriffithides* is rather similar to that of *Pseudophillipsia* but possesses a smaller number of segments.

Genus PERMOPROETUS Toumansky
Plate 49, figure 11

Permoproetus Toumansky, 1935. Perm.-Carb. Tril. Crimea, p. 31 (53).

Genotype: *Permoproetus teschi* Toumansky, 1935, p. 32 (53), here designated, Middle Permian limestone, Crimea.

Generic Characters—Glabella greatly inflated, expanding in front, without flat anterior marginal band. Lateral glabellar furrows inconspicuous. Neck ring divided into three lobes, central one largest, elongated transversely, outer ones elongated longitudinally, somewhat oblique. Fixed cheeks very narrow; palpebral lobes of moderate size. Free cheeks unknown.

Probably nine thoracic segments.

Pygidium broadly semi-oval. Axis prominent, about one-third as wide as entire pygidium, composed of 7 to 9 segments. Pleural lobes of 5 or 6 segments separated by distinct furrows. Flange of moderate width, somewhat flattened.

Granulose ornamentation fine or absent.

Range—Middle Permian of Crimea and Sicily.

Remarks—The status of this genus is somewhat uncertain as it is possible that the glabellar characters have been misinterpreted. It seems possible, from the nature of the specimens studied by Toumansky, that the neck ring may have been broken away from several of his specimens and that it may have been mistaken for the first thorasic segment in others. The three lobes supposed to occur on the neck ring have the appearance of preoccipital and basal lobes although it is also possible that the two lateral lobes are actually basal lobes that have encroached greatly upon the neck ring or that they are occipital lobes comparable to those present in several Silurian and Devonian proetid species. Toumansky's emphasis upon the fact that the occipital furrow is not continuous with the furrows limiting the posterior cheek rims (how this can be determined without knowledge of the free cheeks is unexplained) suggests that the first alternative suggestion offered above may be correct. Of course these furrows are not actually continuous in any proetid species but ordinarily the discrepancy is too slight to provoke comment.

Toumansky's restoration of the type species is open to criticism because 11 thoracic segments are shown, although only 8 have been observed on any specimen, and it may be confidently assumed that nine is the correct number. It is also unlikely that the cephalon and pygidium are so unequal in size.

If Toumansky's interpretation of the glabellar structure of this genus is correct, it is similar to *Proetus* s.s. except for the absence of a flattened anterior marginal band, or to *Neoproetus* except for the encroaching of the basal lobes upon the neck ring.

The wide pygidium is proetoid but appears to lack well defined subsidiary furrows upon the segments and possesses a well defined flange, thereby differing from most species of *Proetus* and its near relatives. The pygidium of *Permoproetus* is much more strongly segmented than that of *Paraphillipsia*.

Genus PARAPHILLIPSIA Toumansky
Plate 49, figure 14

Paraphillipsia Toumansky, 1935. Permi.-Carb. Tril. Crimea, p. 19 (45).

Genotype: *Paraphillipsia karpinskyi* Toumanski, ibid, p. 20 (45), by original designation, Middle Permian limestone, Crimea.

Generic Characters—Cephalon without flat marginal band anterior to glabella. Glabella expanded in front. Basal lobes large, elongated longitudinally, neither elevated nor depressed; basal furrows strongly curved in front, gently curved behind. Lateral furrows short, curved, inclined forward from axial furrows. Fixed cheeks narrow, not widening notably anteriorly; palpebral lobes very narrow. Free cheeks narrow, steeply sloping; eyes moderately small; genal spines probably very short or absent.

Thorax with nine segments.

Pygidium very broad, segmentation weak. Axis wide, comparatively low, rather uniformly arched transversely. Flange wide,

not notably flattened. Axial segments 7 to 10, pleural segments 5 to 7.

Granulose ornamentation present or absent.

Range—Middle Permian of the Crimea and Central Himalayas.

Remarks—The diplotype is an imperfect enrolled specimen.

Toumansky appears to have had no very clear idea of *Paraphillipsia* except that it has "a cephalon which is typical of the genus *Phillipsia* and a pygidium typical of the genus *Proteus*." As a matter of fact, neither of these parts is typical of the genus named except very superficially. Three of the four other species assigned to *Paraphillipsia* are certainly not congeneric with the genotype and the fourth, if correctly interpreted, differs in the relation of basal lobes and neck ring.

The reconstructed figure of the genotype is inaccurate as it shows the facial sutures curving outward and cutting the lateral margins of the cephalon in advance of the genal angles. In the text, however, Toumansky states that "the branches of the facial suture begin in the posterior part of the cephalon not far from the dorsal furrows . . . ."

If strictly interpreted on the basis of its genotype, *Paraphillipsia* appears to be a valid recognizable genus.

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CRETACEOUS FORAMINIFERA FROM THE MARLBROOK MARL OF ARKANSAS[1]

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ABSTRACT—The foraminiferal fauna of the Marlbrook marl of Upper Cretaceous Taylor age is recorded from collections made at or near the type locality. Seventy-eight species and varieties are listed and one new name is proposed.

THE Marlbrook marl is of Taylor age, unconformably underlying the Saratoga chalk and conformably overlying the Annona chalk. In the Lexicon of Geologic Names of the United States Geological Survey the following information is given for the Marlbrook marl:

Typically exposed for a little over 1 mi. N. of Saratoga, on road to Mineral Springs, Howard Co. Also exposed along Marlbrook Creek, in T. 10 S., R. 24 W., Hempstead Co., Ark.

The samples used in this study were collected by the junior author and are from Howard, Clark, and Hempstead Counties. We are indebted to Dr. Lloyd W. Stephenson of the U. S. Geological Survey for assistance in checking their stratigraphic position. Many of the species range vertically both higher and lower in the Cretaceous but a few of them may be found useful in close stratigraphic correlation.

Location of collecting stations in the Marlbrook marl:

208. Highway 51, 10.7 miles southwest of junction with Highway 26, at Tower No. 6, Unit 6, Arkansas Forestry Service, 3.0 miles northeast of Okolona, Clark County, Arkansas.
273. Natural outcrop on north side of road, 2 miles east of Saratoga on road to Columbus, Howard County, Arkansas.
302. Highway 73, 1.7 miles east of junction with Highway 55 near Saratoga, Howard County, Arkansas.
332. Natural outcrop on east side of road, 3.2 miles south of Yancey on road to Columbus, Hempstead County, Arkansas.
337. Natural outcrop on east side of road, Highway 4, 3.8 miles north of Washington on road to Ozan, Hempstead County, Arkansas.
341. Natural outcrop on north side of road, Highway 73, 1.6 miles east of junction with Highway 55, near Saratoga, Howard County, Arkansas.
357. Three quarters of a mile northeast of Columbus, about ¼ mile east of road from Columbus to Yancey, Hempstead County, Arkansas.

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SYSTEMATIC DESCRIPTIONS

Family LITUOLIDAE

Genus HAPLOPHRAGMOIDES Cushman, 1910

HAPLOPHRAGMOIDES RUGOSA Cushman and Waters

Plate 50, figure 1

Haplophragmoides rugosa Cushman and Waters, 1927, Cushman Lab. Foram. Research Contr., vol. 2, pt. 4, p. 83, pl. 10, figs. 4a, b.—Cushman, 1927, Royal Soc. Canada Trans., ser. 3, vol. 21, sec. 4, p. 128, pl. 1, fig. 2.—Cushman, 1931, Tennessee Div. Geology Bull. 41, p. 17, pl. 1, figs. 3a, b.—Cushman, 1933, Cushman Lab. Foram. Research Spec. Publ. 5, pl. 4, figs. 27a, b.

The known occurrences of this species include the Arkadelphia marl and Prairie Bluff chalk of Navarro age, the upper part of the Taylor marl and the middle part of the Selma chalk. The Marlbrook specimens are typical and occur at stations 273, 302, 332, and 357.

Genus AMMOBACULITES Cushman, 1910

AMMOBACULITES COPROLITHIFORMIS (Schwager)

Plate 50, figure 2

Haplophragmium coprolithiforme Schwager, 1868, Benecke's Geogn.-paleont. Beitr., vol. 1, p. 654, pl. 34, fig. 3.

Ammobaculites coprolithiforme, Cushman, 1927, Royal Soc. Canada Trans., ser. 3, vol. 21, sec. 4, p. 130, pl. 1, figs. 6, 7.—Cushman and Jarvis, 1932, U. S. Nat. Mus. Proc., vol. 80, art. 14, p. 13, pl. 3, figs. 4, 5.—Wickenden, 1932, Jour. Paleontology, vol. 6, p. 204, pl. 29, fig. 2.—Cushman, 1933, Cushman Lab. Foram. Research, Spec. Publ. 5, pl. 5, fig. 10.—Cushman and Deaderick, 1942, idem, Contr., vol. 18, p. 51, pl. 9, fig. 9.

The species ranges throughout the Upper Cretaceous. It is often distorted in fossiliza-

tion. Specimens occur at stations 208, 337, and 357.

AMMOBACULITES STEPHENSONI Cushman
Plate 50, figure 3

Ammobaculites stephensoni Cushman, 1933, Cushman Lab. Foram. Research Contr., vol. 9, p. 49, pl. 5, figs. 2a, b.

This species ranges from the upper part of the Taylor marl into the Eagle Ford shale but has not been recorded from the Navarro group. It occurs at stations 208, 332, and 357.

AMMOBACULITES FRAGMENTARIUS
Cushman
Plate 50, figure 4

Ammobaculites fragmentaria Cushman, 1927, Royal Soc. Canada, Trans., ser. 3, vol. 21, sec. 4, p. 130, pl. 1, fig. 8.—Cushman, 1931, Tennessee Div. Geology, Bull. 41, p. 18, pl. 1, figs. 4a, b.

Most records of this species are from beds of Taylor age but it occurs rarely in the Navarro group and in beds of Austin age. A single specimen referable to this species was found at station 208.

Family TEXTULARIIDAE
Genus SPIROPLECTAMMINA Cushman, 1927
SPIROPLECTAMMINA NAVARROANA Cushman
Plate 50, figure 5

Spiroplectammina navarroana Cushman, 1932, Cushman Lab. Foram. Research Contr., vol. 8, p. 96, pl. 11, figs. 14a, b.

Records of this species are from the Navarro group but specimens from the Marlbrook marl have been compared with the types and seem identical. They are from stations 208, 273, 332, and 357.

SPIROPLECTAMMINA LAEVIS CRETOSA
Cushman
Plate 50, figure 6

Spiroplectammina laevis cretosa Cushman, 1932, Cushman Lab. Foram. Research Contr., vol. 8, p. 87, pl. 11, figs. 3a, b.—Jennings, 1936, Bull. Am. Paleontology, vol. 23, no. 78, p. 12, pl. 1, figs. 2a, b.—Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 52, pl. 9, fig. 3.—Cushman and Todd, 1942, idem, vol. 18, p. 25, pl. 5, fig. 1.
Spiroplectammina semicomplanata Plummer (not Carsey), 1931, Texas Univ. Bull. 3101, p. 129, pl. 8, fig. 8.

Some records of *Spiroplectammina semicomplanata* (Carsey) probably belong under this variety. It ranges throughout beds of Taylor and into beds of Austin age with a few records from the Navarro group, and two from the Paleocene. It occurs at stations 332 and 357.

Genus TEXTULARIA Defrance, 1824
TEXTULARIA RIPLEYENSIS W. Berry
Plate 50, figures 7, 8

Textularia ripleyensis W. Berry, in Berry and Kelley, 1929, U. S. Nat. Mus. Proc., vol. 76, art. 19, p. 4, pl. 2, fig. 2.—Cushman, 1931, Tennessee Div. Geology Bull. 41, p. 19, pl. 1, figs. 6, 7.—Cushman, 1932, Cushman Lab. Foram. Research Contr., vol. 8, p. 96, pl. 11, figs. 12, 13.—Cushman, 1932, Jour. Paleontology, vol. 6, p. 332.—Sandidge, 1932, idem, p. 267, pl. 41, figs. 6–8.

This species shows some variation in the amount of surface sculpture. It is particularly characteristic of various beds of Taylor age although it occurs in lower members of the Navarro group, especially that part below the Nacatoch sand, whose fauna has much in common with the typical Taylor fauna. It occurs at stations 208, 273, 332, 341, and 357.

Family VERNEUILINIDAE
Genus GAUDRYINA d'Orbigny, 1839
GAUDRYINA RUDITA Sandidge
Plate 50, figures 9, 10

Gaudryina rudita Sandidge, 1932, Am. Midland Naturalist, vol. 13, p. 342, pl. 31, figs. 19, 20.—Cushman, 1937, Cushman Lab. Foram. Research Spec. Publ. 7, p. 46, pl. 7, figs. 8–10.
Textularia agglutinans W. Berry (not d'Orbigny), in Berry and Kelley, 1929, U. S. Nat. Mus. Proc., vol. 76, art. 19, p. 3, pl. 2, fig. 1.
Gaudryina rugosa Cushman (not d'Orbigny), 1931, Tennessee Div. Geology Bull. 41, p. 20, pl. 1, figs. 9, 10.
?Gaudryina minima Cushman (not Egger), 1931, Jour. Paleontology, vol. 5, p. 301, pl. 34, figs. 5a, b.

The surface of this species is decidedly variable, depending probably on the type of material available for the test, but the shape is fairly constant. It occurs mostly in the Navarro group, particularly the lower part, and in the upper beds of Taylor age. It was recorded as *Gaudryina rugosa* and *G. minima* as noted above, but, since those records were published, topotype specimens of those species have been studied, and the American

species is distinct. It occurs at all of the Marlbrook localities listed above and is often fairly common.

GAUDRYINA QUADRANS Cushman
Plate 50, figures 11, 12

Gaudryina quadrans Cushman, 1936, Cushman Lab. Foram. Research Spec. Publ. no. 6, p. 6, pl. 1, figs. 12a, b.—Cushman, 1937, idem, Spec. Publ. no. 7, p. 47, pl. 7, figs. 11, 12.

This species is only recorded from the upper part of the Taylor marl. Its test was evidently easily distorted in fossilization, especially the later chambers. Specimens referable to it occur in material from stations 273, 302, and 337.

GAUDRYINA (SIPHOGAUDRYINA) STEPHENSONI Cushman
Plate 50, figures 13, 14

Gaudryina stephensoni Cushman, 1928, Cushman Lab. Foram. Research Contr., vol. 4, p. 108, pl. 16, figs. 6–8.—Cushman, 1931, Tennessee Div. Geology, Bull. 41, p. 20, pl. 1, figs. 11a, b.—Cushman, 1932, Jour. Paleontology, vol. 6, p. 332.—Sandidge, 1932, idem, p. 268, pl. 41, figs. 13, 14.—Cushman, 1937, Cushman Lab. Foram. Research Spec. Publ. no. 7, p. 74, pl. 11, figs. 4–6, 11.

This species is characteristic of beds of Taylor age although there are a few records from the lower part of the Navarro group but these are not entirely typical. Specimens occur in the Marlbrook marl at stations 208 and 332.

Genus PSEUDOCLAVULINA Cushman, 1936
PSEUDOCLAVULINA CLAVATA (Cushman)
Plate 50, figures 15–17

Clavulina clavata Cushman, 1926, Am. Assoc. Petroleum Geologists Bull., vol. 10. p. 589, pl. 17, fig. 4.—Cushman, 1927, Jour. Paleontology, vol. 1, p. 149, pl. 28, fig. 3.

Clavulina amorpha Cushman (not Cushman, 1926), 1931, Tennessee Div. Geology, Bull. 41, p. 21, pl. 1, figs. 12, 13.

Clavulina parisiensis Sandidge (not d'Orbigny), 1932, Jour. Paleontology, vol. 6, p. 269, pl. 41, fig. 12.

Reophax cylindricus ripleyensis W. Berry, in Berry and Kelley, 1929, U. S. Nat. Mus. Proc., vol. 76, art. 19, p. 2, pl. 1, fig. 5.

Reophax coonensis W. Berry, 1929, idem, p. 2, pl. 3, fig. 23.

Pseudoclavulina clavata, Cushman, 1937, Cushman Lab. Foram. Research Spec. Publ. no. 7, p. 108, pl. 15, figs. 1–13.—Cushman and Deaderick, 1942, idem, Contr., vol. 18, p. 53, pl. 9, figs. 17–22.

This species has appeared under several names. This largely resulted from the character of the original material which did not show full details. Local conditions apparently had much influence on the texture of the wall and the roughness of the exterior, both of which are quite variable. The species has a long range in the American Cretaceous. It occurs at all the Marlbrook stations, usually in considerable numbers.

Genus CLAVULINOIDES Cushman, 1936
CLAVULINOIDES TRILATERA CONCAVA (Cushman)
Plate 50, figures 18–21

Clavulina trilatera concava Cushman, 1931, Jour. Paleontology, vol. 5, p. 302, pl. 34, figs. 12a, b.

Clavulina trilatera, Cushman (not Cushman, 1926), 1931, Tennessee Div. Geology Bull. 41, p. 22, pl. 2, figs. 1–3.

Clavulina insignis Sandidge (not Plummer), 1932, Am. Midland Naturalist, vol. 13, p. 192, pl. 19, figs. 1–4.

Clavulinoides trilatera concava, Cushman, 1937, Cushman Lab. Foram. Research Spec. Publ. 7, p. 121, pl. 16, figs. 19–25.

This variety is characteristic of beds of Taylor age and that part of the Navarro group below the Nacatoch sand. It grades into the typical form of the species and there is evidently some difference in the shape of the microspheric and megalospheric tests. In the Marlbrook marl it occurs at stations 273, 302, 332, 337, 341, and 357.

Family VALVULINIDAE
Genus DOROTHIA Plummer, 1931
DOROTHIA BULLETTA (Carsey)
Plate 50, figure 22

Gaudryina bulletta Carsey, 1926, Texas Univ. Bull. 2612, p. 28, pl. 4, fig. 4.

Dorothia bulletta, Plummer, 1931, idem, Bull. 3101, p. 132, pl. 8, figs. 13–17.—Sandidge, 1932, Jour. Paleontology, vol. 6, p. 271, pl. 41, figs. 9, 10.—Cushman, 1933, Cushman Lab. Foram. Research Spec. Publ. 4, pl. 12, figs. 8a, b.—Cushman, 1933, idem, Spec. Publ. 5, pl. 8, figs. 10a, b.—Cushman, 1936, Geol. Soc. America Bull., vol. 47, p. 416, pl. 1, figs. 2a, b.—Jennings, 1936, Bull. Am. Paleontology, vol. 23, no. 78, p. 14, pl. 1, fig. 12.—Albritton and Phleger, 1937, Jour. Paleontology, vol. 11, p. 350.—Cushman, 1937, Cushman Lab. Foram. Research Spec. Publ. 8, p. 84, pl. 9, figs. 4–9.—Loetterle, 1937, Nebraska Geol. Survey ser. 2, Bull. 12, p. 58, pl. 10, figs. 6a, b.—Cushman and Hedberg, 1941, Cushman Lab.

Foram. Research Contr., vol. 17, p. 85, pl. 21, figs. 12a, b.

This species is abundant in various members of the Navarro group and also in upper beds of Taylor age. It is rather rare in the Marlbrook marl, occurring at stations 273, 332, and 341.

Family TROCHAMMINIDAE
Genus TROCHAMMINA Parker and Jones, 1859
TROCHAMMINA DIAGONIS (Carsey)
Plate 50, figure 23

Haplophragmoides diagonis Carsey, 1926, Texas Univ. Bull. 2612, p. 22, pl. 3, fig. 1.
Trochammina diagonis, Cushman and Waters, 1927, Cushman Lab. Foram. Research Contr., vol. 2, pt. 4, p. 84, pl. 10, figs. 7a–c.—Cushman, 1927, Royal Soc. Canada Trans., ser. 3, vol. 21, sec. 4, p. 132.—Plummer, 1931, Texas Univ. Bull. 3101, p. 140.—Cushman, 1933, Cushman Lab. Foram. Research Spec. Publ. 5, pl. 18, figs. 2a–c.—Cushman and Deaderick, 1942, idem, Contr., vol. 18, p. 55, pl. 10, figs. 8, 9.

Most records of this species are from the Navarro group with a very few from upper beds of Taylor age and one from the Brownstown marl of Austin age. Specimens are often distorted. It occurs only at stations 273 and 302.

Family LAGENIDAE
Genus ROBULUS Montfort, 1808
ROBULUS PONDI Cushman
Plate 50, figure 24

Robulus pondi Cushman, 1931, Tennessee Div. Geology Bull. 41, p. 25, pl. 2, figs. 9a, b.—Cushman, 1941, Cushman Lab. Foram. Research Contr., vol. 17, p. 56, pl. 15, fig. 4.

This is a common species in upper beds of Taylor age and lower beds of Navarro age. It occurs at all stations in the Marlbrook marl.

ROBULUS TAYLORENSIS (Plummer)
Plate 50, figure 25

Astacolus taylorensis Plummer, 1931, Texas Univ. Bull. 3101, p. 143, pl. 11, figs. 16a, b; pl. 15, figs. 8–11.—Albritton and Phleger, 1937, Jour. Paleontology, vol. 11, p. 351.
Cristellaria gibba Carsey (not d'Orbigny), 1926, Texas Univ. Bull. 2612, p. 37, pl. 5, figs. 4a, b.
Robulus taylorensis, Cushman, 1941, Cushman Lab. Foram. Research Contr., vol. 17, p. 57, pl. 15, figs. 5a, b.—Cushman and Deaderick, 1942, idem, vol. 18, p. 56, pl. 10, figs. 14, 15.

This is a characteristic Taylor species. It occurs only at station 332. It may be related to *Marginulina stephensoni* but is a much larger species and shows but little tendency to uncoil.

ROBULUS STEPHENSONI Cushman
Plate 50, figure 26

Robulus stephensoni Cushman, 1939, Cushman Lab. Foram. Research Contr., vol. 15, p. 90, pl. 16, figs. 2, 3.—Cushman, 1941, idem, vol. 17, p. 63, pl. 16, figs. 6a, b.
Robulus navarroensis Cushman (not Plummer), 1931, Tennessee Div. Geology Bull. 41, p. 25, pl. 2, figs. 8a, b.

Specimens referable to this species occur at all stations in the Marlbrook marl. It is known from upper beds of Taylor age and the lower part of the Navarro group.

ROBULUS cf. R. MÜNSTERI (Roemer)
Plate 50, figure 28

Rare specimens from station 273 may be referred to this species with some question.

Genus LENTICULINA Lamarck, 1804
LENTICULINA cf. L. ROTULATA Lamarck
Plate 50, figure 27

Many forms have been referred to this species. The specimens from the Marlbrook marl have no ventral slit on the apertural face. The umbonal area is well developed and occasionally has strongly developed costae across the umbo. Specimens referred here are from stations 302, 337, and 341.

Genus MARGINULINA d'Orbigny, 1826
MARGINULINA STEPHENSONI Cushman
Plate 51, figures 1–3

Marginulina stephensoni Cushman, 1937, Cushman Lab. Foram. Research Contr., vol. 13, p. 93, pl. 13, figs. 10, 11.

This species occurs mostly in beds of Taylor age but there are single recorded occurrences in lower beds of Navarro age and in the Austin chalk. The only specimens found in the Marlbrook marl are from station 208.

MARGINULINA MUNDA Cushman
Plate 51, figure 4

Marginulina munda Cushman, 1938, Cushman Lab. Foram. Research Contr., vol. 14, p. 34, pl. 5, figs. 11, 12.

A single specimen was found in material

from station 208. The only previous records of the species are from the upper part of the Taylor marl of Texas.

MARGINULINA CRETACEA Cushman
Plate 51, figure 5

Marginulina cretacea Cushman, 1937, Cushman Lab. Foram. Research Contr., vol. 13, p. 94, pl. 13, figs. 12–15.

Records of this species are almost entirely from beds of Taylor age but it occurs rarely in the Neylandville marl of Navarro age. In the Marlbrook material it occurs at stations 208, 332, and 337.

MARGINULINA TEXASENSIS Cushman
Plate 51, figures 6, 7

Marginulina texasensis Cushman, 1938, Cushman Lab. Foram. Research Contr., vol. 14, p. 95.
Marginulina texana Cushman, 1937, idem, vol. 13, p. 95, pl. 14, figs. 1–4.

This species occurs in Texas in the upper part of the Taylor marl, in the Pecan Gap chalk member, and in the Annona chalk. Its vertical range includes the Saratoga chalk of Arkansas and the Selma chalk of Mississippi. It is common in the Marlbrook marl, occurring at stations 208, 273, 302, 332, 341, and 357.

Genus DENTALINA d'Orbigny, 1826
DENTALINA ALTERNATA (Jones)
Plate 51, figure 11

Nodosaria zippei alternata Jones, in Wright, 1886, Belfast Nat. Field Club, Proc., 1884–85, appendix 9, p. 330, pl. 27, fig. 10.
Dentalina alternata, Plummer, 1931, Texas Univ. Bull. 3101, p. 153, pl. 11, fig. 7.—Sandidge, 1932, Jour. Paleontology, vol. 6, p. 274, pl. 42, fig. 6.—Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 76, pl. 13, figs. 2–6.
Nodosaria alternata, Carsey, 1926, Texas Univ. Bull. 2612, p. 35, pl. 4, fig. 7.
Nodosaria intercostata Cushman (not Reuss), 1931, Tennessee Div. Geology Bull. 41, p. 31, pl. 4, figs. 1, 2.
Nodosaria affinis Cushman (part) (not Reuss), 1931, Jour. Paleontology, vol. 5, p. 305, pl. 35, fig. 2 (not figs. 3–5).
Dentalina pinnigera Sandidge, 1932, idem, vol. 6, p. 274, pl. 42, figs. 11, 12.

This is a wide ranging species known from upper beds of Austin age through beds of Taylor age into lower beds of Navarro age. It occurs at all seven Marlbrook stations.

DENTALINA BASITORTA Cushman
Plate 51, figures 9, 10

Dentalina basitorta Cushman, 1938, Cushman Lab. Foram. Research Contr., vol. 14, p. 37, pl. 6, figs. 4, 5.—Cushman, 1940, idem, vol. 16, p. 80, pl. 13, figs. 21, 22.
Dentalina cf. *D. basitorta*, Cushman and Hedberg, 1941, idem, vol. 17, p. 88, pl. 21, fig. 24.

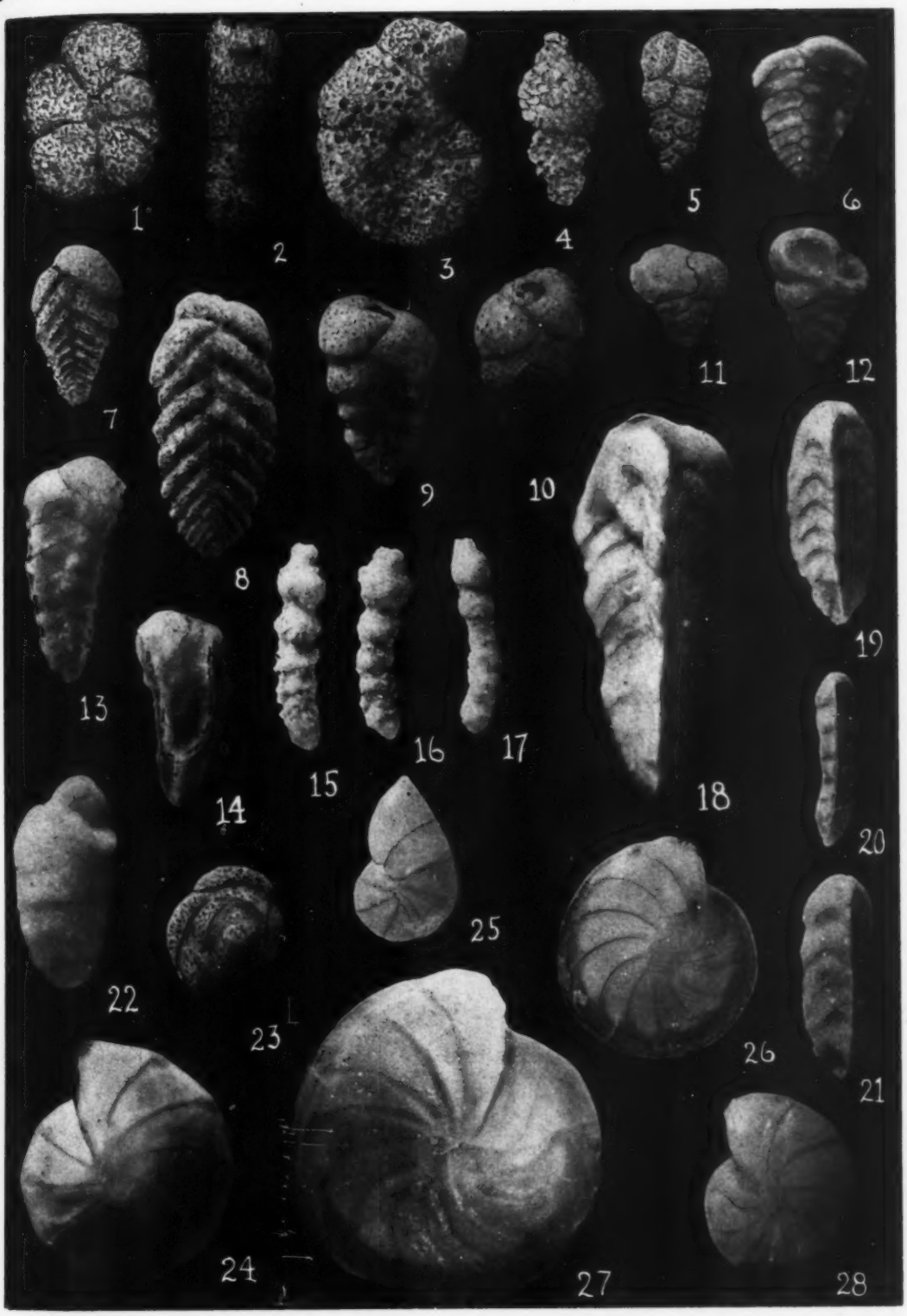
Records of this species are from various beds of Taylor age with a single questionable one possibly of Navarro age. It occurs in the Marlbrook marl at stations 273 and 357.

DENTALINA MEGALOPOLITANA Reuss
Plate 51, figure 8

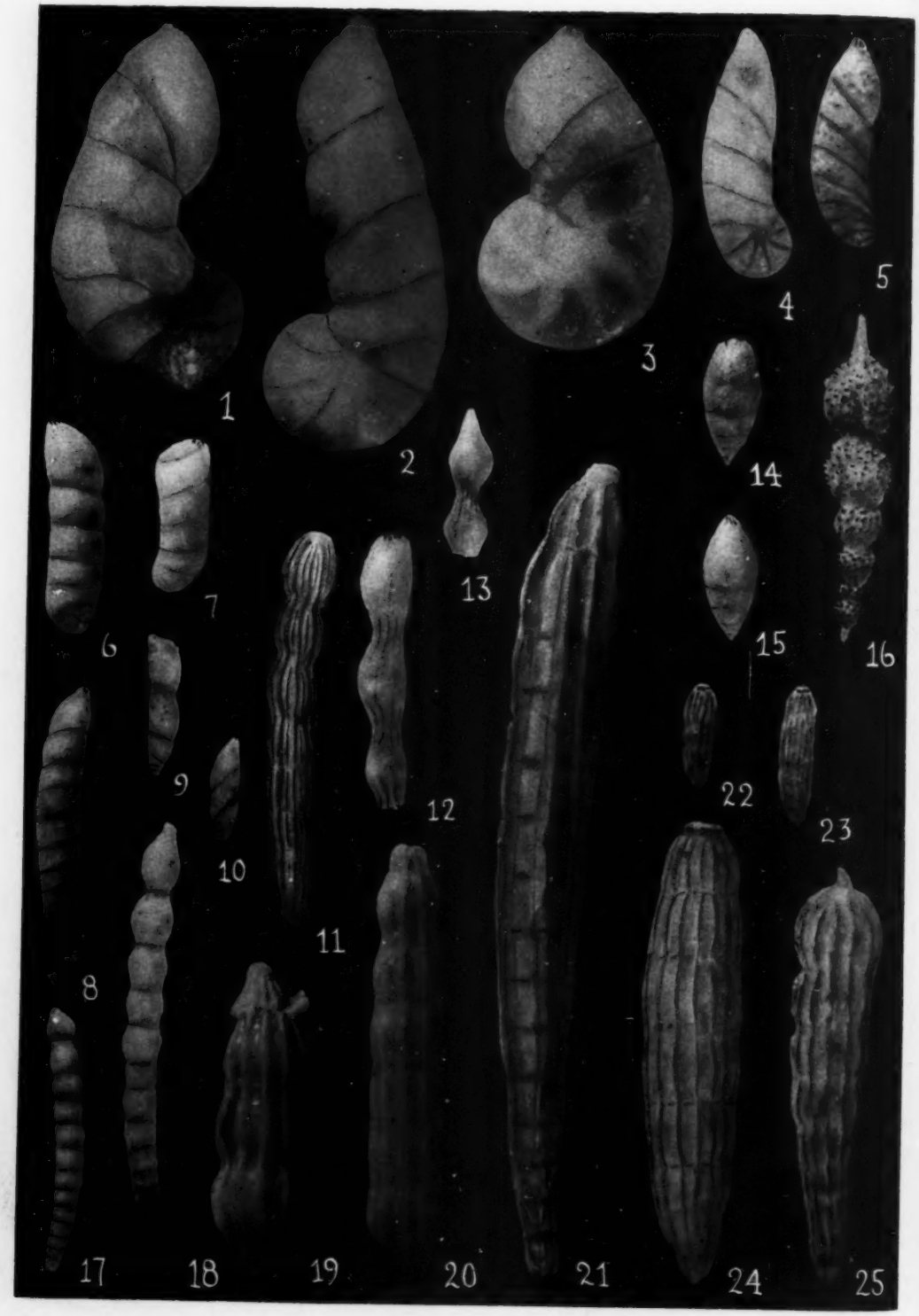
Dentalina megalopolitana Reuss, 1855, Deutsch. geol. Gesell. Zeitschr., vol. 7, p. 267, pl. 8.

EXPLANATION OF PLATE 50

FIGS. *1*—*Haplophragmoides rugosa* Cushman and Waters, sta. 302, ×24. (p. 328)
2—*Ammobaculites coprolithiformis* (Schwager), sta. 357, ×42. (p. 328)
3—*Ammobaculites stephensoni* Cushman, sta. 332, ×42. (p. 329)
4—*Ammobaculities fragmentarius* Cushman, sta. 208, ×36. (p. 329)
5—*Spiroplectammina navarroana* Cushman, sta. 332, ×36. (p. 329)
6—*Spiroplectammina laevis cretosa* Cushman, sta. 332, ×42. (p. 329)
7, 8—*Textularia ripleyensis* W. Berry, sta. 341, 7, ×24; 8, ×42. (p. 329)
9, 10—*Gaudryina rudita* Sandidge, sta. 337, ×42. (p. 329)
11, 12—*Gaudryina quadrans* Cushman, sta. 273, ×42. (p. 330)
13, 14—*Gaudryina* (*Siphogaudryina*) *stephensoni* Cushman, sta. 332, ×42. (p. 330)
15–17—*Pseudoclavulina clavata* (Cushman), sta. 302, ×24. (p. 330)
18–21—*Clavulinoides trilatera concava* (Cushman), *18, 19*, sta. 337; *20, 21*, sta. 273, ×24. (p. 330)
22—*Dorothia bulletta* (Carsey), sta. 341, ×42. (p. 330)
23—*Trochammina diagonis* (Carsey), sta. 273, ×42. (p. 331)
24—*Robulus pondi* Cushman, sta. 337, ×24. (p. 331)
25—*Robulus taylorensis* (Plummer), sta. 332, ×24. (p. 331)
26—*Robulus stephensoni* Cushman, sta. 302, ×24. (p. 331)
27—*Lenticulina* cf. *rotulata* Lamarck, sta. 337, ×24. (p. 331)
28—*Robulus* cf. *münsteri* (Roemer), sta. 273, ×42. (p. 331)



Cushman and Deadrick—Cretaceous Foraminifera



Cushman and Deadrick—Cretaceous Foraminifera

fig. 10.—Cushman, 1931, Jour. Paleontology, vol. 5, p. 304, pl. 34, fig. 17.—Cushman, 1931, Tennessee Div. Geology Bull. 41, p. 29, pl. 3, fig. 8.—Cushman, 1932, Jour. Paleontology, vol. 6, p. 335.—Cushman and Jarvis, 1932, U. S. Nat. Mus. Proc., vol. 80, art. 14, p. 29, pl. 9, fig. 5.—Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 80, pl. 13, figs. 26–28.

Nearly all of the American Cretaceous records of this species are from beds of Taylor age with a very few from the basal part of the Navarro group. It is common in the Marlbrook material, occurring at stations 208, 273, 302, 332, 337, and 357.

Dentalina basiplanata Cushman
Plate 51, figures 17, 18

Dentalina annulata Cushman (not Reuss), 1931, Tennessee Div. Geology, Bull. 41, p. 28, pl. 3, fig. 3.
Dentalina basiplanata Cushman, 1938, Cushman Lab. Foram. Research Contr. vol. 14, p. 38, pl. 6, figs. 6–8.—Cushman, 1940, idem, vol. 16, p. 82, pl. 14, figs. 1–6.
Dentalina cf. *D. basiplanata*, Cushman and Hedberg, 1941, idem, vol. 17, p. 88, pl. 21, fig. 23.

This species ranges through the entire sequence of beds of Taylor and Navarro ages. It occurs at all seven Marlbrook stations.

Dentalina solvata Cushman
Plate 51, figures 12, 13

Dentalina solvata Cushman, 1938, Cushman Lab. Foram. Research Contr., vol. 14, p. 39, pl. 6, figs. 9–14.—Cushman, 1940, idem, vol. 16, p. 83, pl. 14, figs. 13–17.

Most records of this species are from upper beds of Taylor age but there are single records from the basal Navarro group and upper part of the Austin chalk.

Genus Nodosaria Lamarck, 1812

Nodosaria affinis Reuss
Plate 51, figures 19–21

Nodosaria affinis Reuss, 1845–46, Verstein. böhm. Kreide, pt. 1, 1845, p. 26, pl. 13, fig. 16.—Reuss, 1874, Palaeontographica, vol. 20, pt. 2, 1872–75, p. 83, pl. 2 (20), fig. 12.—Perner, 1892, Foram. česk. cenomanu, p. 57, pl. 6, figs. 10, 14.—Franke, 1925, Greifswald Univ., Geol.-paleont. Inst., Abh., vol. 6, p. 37, pl. 3, fig. 25.—W. Berry and Kelly, 1929, U. S. Nat. Mus. Proc., vol. 76, art. 19, p. 6, pl. 1, fig. 8.—Cushman, 1931, Tennessee Div. Geology Bull. 41, p. 30, pl. 3, figs. 16–20.—Cushman, 1931, Jour. Paleontology, vol. 5, p. 305, pl. 35, figs. 3–5 (not fig. 2).—Cushman, 1931, Cushman Lab. Foram. Research Contr., vol. 7, p. 38, pl. 5, fig. 4.—Cushman and Jarvis, 1932, U. S. Nat. Mus. Proc., vol. 80, art. 14, p. 34, pl. 10, fig. 13.—Cushman, 1936, Geol. Soc. America Bull., vol. 47, p. 417.—Albritton and Phleger, 1937, Jour. Paleontology, vol. 11, p. 351.—Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 86, pl. 15, figs. 8–23.—Cushman and Deaderick, 1942, idem, vol. 18, p. 58, pl. 11, figs. 7–11.
Nodosaria proxima W. Berry and Kelley (not Silvestri), 1929, U. S. Nat. Mus. Proc., vol. 76, art. 19, p. 7, pl. 1, fig. 13.

This wide-ranging species occurs at stations 208, 273, 332, 337, 341, and 357.

Nodosaria aspera Reuss
Plate 51, figure 16

Nodosaria aspera Reuss, 1845–46, Verstein. böhm. Kreide., pt. 1, 1845, p. 26, pl. 13, figs. 14, 15.—Reuss (in Geinitz), 1845–46, Grundriss der Verstein., p. 653, pl. 24, fig. 4.—Egger, 1899, K. bayer. Akad. Wiss., Math.-naturh. Abt., Abh., Kl. 2, vol. 21, pt. 1, p. 80, pl. 8, fig. 15.—Franke, 1928, Preuss. geol. Landesanstalt Abh., n. ser., vol. 111, p. 50, pl. 4, fig. 14.—Cushman and Jarvis, 1932, U. S. Nat. Mus. Proc., vol. 80, art. 14, p. 35, pl. 11,

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Explanation of Plate 51

Figs. *1–3*—*Marginulina stephensoni* Cushman, sta. 208, ×36. (p. 331)
4—*Marginulina munda* Cushman, sta. 208, ×36. (p. 331)
5—*Marginulina cretacea* Cushman, sta. 332, ×42. (p. 332)
6, 7—*Marginulina texasensis* Cushman, sta. 302, ×24. (p. 332)
8—*Dentalina megalopolitana* Reuss, sta. 302, ×24. (p. 332)
9, 10—*Dentalina basitorta* Cushman, sta. 273, ×24. (p. 332)
11—*Dentalina alternata* (Jones), sta. 332, ×24. (p. 332)
12, 13—*Dentalina solvata* Cushman, sta. 332, 12, ×42; 13, ×24. (p. 333)
14, 15—*Pseudoglandulina lagenoides* (Olszewski), sta. 273, ×42. (p. 334)
16—*Nodosaria aspera* Reuss, sta. 208, ×36. (p. 333)
17, 18—*Dentalina basiplanata* Cushman, sta. 332, ×24. (p. 333)
19–21—*Nodosaria affinis* Reuss, sta. 337, ×24. (p. 333)
22–24—*Nodosaria obscura* Reuss, 22, 23, sta. 337, ×24; 24, sta. 208, ×36. (p. 334)
25—*Nodosaria proboscidea* Reuss, sta. 208, ×36. (p. 334)

fig. 5.—Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 88, pl. 16, fig. 2.

The American records of this species are from beds of Taylor age. It occurs only at station 208.

NODOSARIA PROBOSCIDEA Reuss
Plate 51, figure 25

Nodosaria proboscidea Reuss, 1851, Haidinger's Naturwiss. Abh., vol. 4, pt. 1, p. 23, pl. 1, fig. 6.—Cushman, 1940, Cushman Lab. Foram. Research, Contr., vol. 16, p. 89, pl. 16, figs. 8, 9.

The few American records of this species are from upper beds of Taylor age. Excellent specimens occur at station 208.

NODOSARIA OBSCURA Reuss
Plate 51, figures 22–24

Nodosaria obscura Reuss, 1845–46, Verstein. böhm. Kreide., pt. 1, 1845, p. 26, pl. 13, figs. 7–9.—Reuss (in Geinitz), 1845–46, Grundriss der Verstein., p. 653, pl. 24, fig. 3. Reuss, 1872–75, Palaeontographica, vol. 20, pt. 2, 1874, p. 81, pl. 2 (20), figs. 1–4.—Heron-Allen and Earland, 1910, Royal Micr. Soc. Jour., p. 418, pl. 7, fig. 7.—Franke, 1925, Greifswald Univ., Geol.-paleont. Inst., Abh., vol. 6, p. 43, pl. 3, fig. 40.—Storm, 1929, Lotos, vol. 77, p. 47, pl., figs. 1–5.—Cushman, 1931, Tennessee Div. Geology Bull. 41, p. 32, pl. 4, figs. 3, 4.—Brotzen, 1936, Sveriges geol. undersökning, ser. C, no. 396, p. 84, pl. 5, figs. 24, 25; text figs. 26, 27.—Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 90, pl. 16, figs. 11, 12.

This species occurs most abundantly in America in upper beds of Taylor age but there are also a few records from the Navarro group. It occurs at stations 208, 273, 337, and 357.

Genus PSEUDOGLANDULINA Cushman, 1929
PSEUDOGLANDULINA LAGENOIDES (Olszewski)
Plate 51, figures 14, 15

Glandulina lagenoides Olszewski, 1875, Sprawozd. Kom. Fizyj. Akad. Umiej., Krakowie, vol. 9, p. 107, pl. 1, fig. 6.
Pseudoglandulina sp. Plummer, 1931, Texas Univ. Bull. 3101, p. 158, pl. 10, figs. 16, 17.—Albritton and Phleger, 1937, Jour. Paleontology, vol. 11, p. 351.
Pseudoglandulina lagenoides, Cushman and Hedberg, 1941, Cushman Lab. Foram. Research Contr., vol. 17, p. 89, pl. 21, fig. 34.

American records are from upper beds of Taylor age and from the Navarro group. It occurs at station 273 only.

Genus VAGINULINA d'Orbigny, 1826
VAGINULINA WADEI Kelley
Plate 52, figures 1, 2

Vaginulina wadei Kelley, in W. Berry and Kelley, 1929, U. S. Nat. Mus. Proc., vol. 76, art. 19, p. 8, pl. 1, fig. 7.—Cushman, 1936, Geol. Soc. America Bull., vol. 47, p. 417, pl. 1, fig. 4.
Vaginulina cf. *V. simondsi* Cushman, 1931, Tennessee Div. Geology, Bull. 41, p. 34, pl. 4, figs. 8a, b.
Vaginulina webbervillensis Cushman (not Carsey), 1931, idem, p. 33, pl. 4, fig. 6.

This species ranges from upper beds of Austin age through beds of Taylor age and into lower beds of Navarro age. It occurs at stations 208, 337, and 357.

VAGINULINA MULTICOSTATA Cushman
Plate 52, figure 3

Vaginulina multicostata Cushman, 1930, Cushman Lab. Foram. Research Contr., vol. 6, p. 28, pl. 4, fig. 4.—Albritton and Phleger, 1937, Jour. Paleontology, vol. 11, p. 351.
Vaginulina simondsi Cushman (part) (not Carsey), 1931, Tennessee Div. Geology, Bull. 41, p. 33, pl. 4, fig. 7.—Cushman, 1931, Jour. Paleontology, vol. 5, p. 306, pl. 35, fig. 7.

This species ranges throughout beds of Taylor and Navarro ages. It occurs at stations 302 and 337.

VAGINULINA TAYLORANA Cushman
Plate 52, figure 4

Vaginulina taylorana Cushman, 1938, Cushman Lab. Foram. Research Contr., vol. 14, p. 36, pl. 5, figs. 19a, b.

Records of this species are from the upper part of the Taylor marl with a single one from the lower part. It occurs at stations 208 and 337.

Genus PALMULA Lea, 1833
PALMULA SUTURALIS (Cushman)
Plate 52, figure 5

Flabellina rugosa Heron-Allen and Earland (not d'Orbigny), 1910, Royal Micr. Soc. Jour., p. 422, pl. 8, fig. 7.—Franke, 1925, Greifswald Univ., Geol.-paleont. Inst., Abh., vol. 6, p. 64, pl. 5, fig. 12.—Franke, 1928, Preuss. geol. Landesanstalt, Abh., n. ser., vol. 111, p. 92, pl. 8, figs. 18a, b.—Cushman, 1930, Cushman Lab. Foram. Research Contr., vol. 6, p. 32, pl. 4, fig. 15.—Cushman, 1931, Jour. Paleontology, p. 307, pl. 35, fig. 10.—Plummer, 1931, Texas Univ. Bull. 3101, p. 166, pl. 12, figs. 4a, b.—Cushman, 1931, Cushman Lab. Foram. Research Contr., vol. 7, p. 38, pl. 5, fig. 3.—Sandidge, 1932, Jour. Paleontology, p. 279, pl. 42, fig. 22.

Flabellina suturalis Cushman, 1935, Cushman Lab. Foram. Research Contr., vol. 11, p. 86, pl. 13, figs. 9–18.—Albritton and Phleger, 1937, Jour. Paleontology, vol. 11, p. 351.

Palmula suturalis, Loetterle, 1937, Nebraska Geol. Survey, ser. 2, Bull. 12, p. 28, pl. 3, fig. 5.—Cushman and Deaderick, 1942, Cushman Lab. Foram. Research Contr., vol. 18, p. 60, pl. 13, fig. 1.

This species ranges from beds of Austin age through beds of Taylor age and into lower beds of Navarro age. It is common in the Marlbrook marl, occurring at stations 208, 273, 302, 332, 337, and 357.

PALMULA RUGOSA (d'Orbigny)
Plate 52, figure 7

Flabellina rugosa d'Orbigny, 1840, Soc. Géol. France Mém., ser. 1, vol. 4, p. 23, pl. 2, figs. 4, 5, 7.—Reuss (in Geinitz), 1845–46, Grundriss der Verstein., p. 658, pl. 24, fig. 23.—d'Orbigny, 1850, Prodrome de paleontologie stratigraphique universelle des animaux mollusques et rayonnes, vol. 2, p. 281, no. 1379.—Reuss, 1854, Akad. Wiss. Wien, Math.-naturwiss. Kl., Denkschr., vol. 7, p. 67.—Reuss, 1860, idem, Sitzungsber., vol. 40, p. 215.—Reuss, 1865, idem, vol. 52, abt. 1, p. 453.—Karrer, 1870, K. k. geol. Reichsanstalt, Jahrb., vol. 20, p. 176.—Marsson, 1878, Naturwiss. Ver. Neu-Vorpommern u. Rügen, Mitth., Jahrg. 10, p. 140.—Goës, 1889, Kongl. Svensk. Vet.-Akad. Handl., vol. 15, pt. 4, no. 2, pl. 2, fig. 4.—Beissel, 1891, K. preuss. geol. Landesanstalt, Abh., n. ser., vol. 3, p. 47, pl. 9, figs. 20–24; pl. 16, figs. 30, 31.—Egger, 1899, K. bayer. Akad. Wiss., Math.-naturh. Abt., Abh., Kl. 2, vol. 21, pt. 1, p. 108, pl. 10, figs. 5, 6; pl. 13, figs. 1, 2.—Egger, 1907, Naturwiss. Ver. Passau, Ber., p. 30, pl. 1, fig. 8.—Cushman, 1927, Cushman Lab. Foram. Research Contr., vol. 3, p. 189.—Cushman, 1933, idem, Spec. Publ. 5, pl. 20, fig. 8.—Brotzen, 1934, Deutschen Palästina-Vereins, Zeitschr., Jahrg., p. 45.—Cushman, 1935, Cushman Lab. Foram. Research Contr., vol. 11, p. 83, pl. 13, figs. 1–6.—Brotzen, 1936, Sveriges geol. undersökning, ser. C, no. 396, p. 107, text figs. 35a, b.—Cole, 1938, Florida Geol. Survey Bull. 16, p. 34 (list), pl. 3, figs. 6.

Flabellina interpunctata von der Marck, 1858, Naturh. Ver. preuss. Rheinlands, Verh., vol. 15, p. 53, pl. 1, fig. 5.—Reuss, 1860, Akad. Wiss. Wien, Math.-naturwiss. Kl., Sitzungsber., vol. 40, p. 216, pl. 9, fig. 1.—Heron-Allen and Earland, 1910, Royal Micr. Soc., Jour., p. 422, pl. 8, fig. 5.—Franke, 1913, Naturh. Ver. preuss. Rheinlande u. Westfalens, Jahrg. 69, 1912, p. 277.—Chapman, 1917, W. Australia Geol. Survey, Bull. 72, p. 34, pl. 10, fig. 91.—Franke, 1925, Greifswald Univ., Geol.-paleont. Inst., Abh., vol. 6, p. 64, pl. 5, fig. 13.—Franke, 1928, Preuss. geol. Landesanstalt, Abh., n. ser., vol. 111, p. 92, pl. 8, fig. 17.—Cushman, 1930, Cushman Lab. Foram. Research Contr., vol. 6, p. 30, pl. 4, figs. 16, 17.—Cushman, 1931, Jour. Paleontology, vol. 5, p. 307, pl. 35, fig. 9.—Plummer, 1931, Texas Univ. Bull. 3101, p. 163, pl. 12, figs. 1–3.—Cushman, 1932, Jour. Paleontology, vol. 6, p. 336.—Sandidge, 1932, Am. Midland Naturalist, vol. 13, p. 194, pl. 19, figs. 12–14.—Sandidge, 1932, Jour. Paleontology, vol. 6, p. 279, pl. 42, fig. 21.

This species occurs mostly in beds of Taylor age but has been recorded once from the upper part of the Austin chalk and several times from the lower part of the Navarro group. It occurs at stations 273, 332, 341, and 357.

PALMULA PRIMITIVA Cushman
Plate 52, figure 6

Palmula simplex Cushman (not Reuss), 1938, Cushman Lab. Foram. Research Contr., vol. 14, p. 36, pl. 6, fig. 1.

Palmula primitiva Cushman, 1939, idem, vol. 15, p. 91, pl. 16, figs. 4, 5.—Cushman and Hedberg, 1941, idem, vol. 17, p. 90, pl. 21, figs. 36, 37.

This seems to be a good index species for upper beds of Taylor age. It occurs only at station 273.

Genus FRONDICULARIA Defrance, 1826

FRONDICULARIA GOLDFUSSI Reuss
Plate 52, figures 11, 12

Frondicularia goldfussi Reuss, 1860, Akad. Wiss. Wien, Math.-naturwiss. Kl., Sitzungsberg., vol. 40, p. 192, pl. 4, figs. 7a, b.—Egger, 1899, K. bayer. Akad. Wiss., Math.-naturh. Abt., Abh., Kl. 2, vol. 21, pt. 1, p. 89, pl. 13, figs. 12, 13, 16, 17.—Cushman, 1930, Cushman Lab, Foram. Research Contr., vol. 6, p. 33, pl. 5, fig. 3.—Cushman, 1936, idem, vol. 12, p. 15. pl. 3, figs. 21, 22.—Cushman and Hedberg, 1941, idem, vol. 17, p. 91, pl. 22, figs. 7–10.

In the American Cretaceous this species is common in beds of Taylor age with some occurrences in beds of Austin age. It occurs at stations 302, 332, and 357.

FRONDICULARIA cf. F. LINEARIS Franke
Plate 52, figures 8, 9

Specimens probably belonging to this species occur at stations 273, 332, and 357. It ranges from upper beds of Austin age through beds of Taylor age.

FRONDICULARIA cf. F. FRANKEI Cushman
Plate 52, figure 10

A specimen from station 302 may belong here.

FRONDICULARIA cf. F. STRIATULA Reuss
Plate 52, figure 14

The only specimens referable to this species are from station 357.

FRONDICULARIA cf. F. CLARKI Bagg
Plate 52, figure 13

A single specimen from station 337 resembles this species.

Genus LAGENA Walker and Jacob, 1798
LAGENA HISPIDA Reuss
Plate 52, figure 16

The only occurrence of this species is at station 273.

LAGENA SUBSTRIATA Williamson
Plate 52, figure 15

A single specimen close to this species occurs at station 273.

Family POLYMORPHINIDAE
Genus GUTTULINA d'Orbigny, 1839
GUTTULINA cf. G. ADHAERENS (Olszewski)
Plate 52, figure 18

Specimens from stations 208 and 332 seem close to this species which, in the American Cretaceous, is largely restricted to the Navarro group.

Genus PYRULINA d'Orbigny, 1839
PYRULINA cf. P. CYLINDROIDES (Roemer)
Plate 52, figure 17

In the American Cretaceous this species ranges through the Navarro group and into upper beds of Taylor age. The only specimens referable to it are from station 357.

Family NONIONIDAE
Genus NONIONELLA Cushman, 1926
NONIONELLA AUSTINANA Cushman
Plate 52, figure 19

Nonionella austinana Cushman, 1933, Cushman Lab. Foram. Research Contr., vol. 9, p. 57, pl. 7, figs. 2a–c.—Cushman, 1939, U. S. Geol. Survey Prof. Paper 191, p. 27, pl. 7, figs. 1, 2.

This species ranges from the Eagle Ford shale through beds of Austin and Taylor ages. It has fewer chambers than *N. cretacea* Cushman which also occurs in beds of Taylor age. The only specimens are from stations 208 and 273.

Family HETEROHELICIDAE
Genus BOLIVINOPSIS Yakovlev, 1891
BOLIVINOPSIS ROSULA (Ehrenberg)
Plate 53, figure 1

Spiroplecta rosula Ehrenberg, 1854, Mikrogeologie, pl. 32, pt. 2, fig. 26.
Spiroplectoides rosula, Cushman, 1927, Cushman Lab. Foram. Research Contr., vol. 3, p. 62, pl. 13, figs. 9a, b; p. 114, pl. 23, figs. 6, 7.—Cushman, 1931, Tennessee Div. Geology Bull. 41, p. 44, pl. 7, figs. 9.—Cushman, 1933, Cushman Lab. Foram. Research Spec. Publ. 4, pl. 21, figs. 12a, b; Spec. Publ. no. 5, pl. 26, fig. 4.—Cushman, 1934, idem, Contr., vol. 10, p. 38, pl. 6, figs. 10–13.
Bolivinopsis rosula, Macfadyen, 1933, Royal Micr. Soc. Jour., vol. 53, p. 141.

This species ranges through beds of Austin, Taylor, and Navarro ages. Specimens occur at stations 273, 302, and 337.

Genus GÜMBELINA Egger, 1899
GÜMBELINA GLOBULOSA (Ehrenberg)
Plate 53, figures 2, 3

Textilaria globulosa Ehrenberg, 1838, K. preuss. Akad. Wiss. Berlin, Abh., p. 135, pl. 4, fig. iv*β*.—Ehrenberg, 1854, Mikrogeologie, pl. 21, fig. 87; etc.—Eley, 1859, Geology in the garden, London, pp. 194, 202, pl. 2, fig. 9; pl. 9, fig. 9.—Franke, 1928, Preuss. geol. Landesanstalt, Abh., n. ser., vol. 111, p. 134, pl. 12, fig. 11.—Cushman, 1928, Jour. Paleontology, vol. 1, p. 215, pl. 34, fig. 8.
Gümbelina globulosa, Egger, 1899, K. bayer, Akad. Wiss., Math.—naturh. Abt., Abh., Kl. 2, vol. 21, pt. 1, p. 32, pl. 14, fig. 43.—Chapman, 1917, W. Australia Geol. Survey, Bull. 72, p. 14, pl. 2, fig. 17.—Chapman, 1926, New Zealand Geol. Survey, Paleontology Bull. 11, p. 33, pl. 8, fig. 5.—Cushman, 1927, Cushman Lab. Foram. Research Contr., vol. 3, p. 190.—?Carman, 1929, Jour. Paleontology, vol. 3, p. 312, pl. 34, figs. 10–20.—White, 1929, idem, vol. 3, p. 36, pl. 4, figs. 10a, b.—Cushman 1931, Tennessee Geol. Survey Bull. 41, p. 43, pl. 7, figs. 3–5.—Cushman, 1931, Cushman Lab. Foram. Research Contr., vol. 7, p. 39, pl. 5, figs. 7a, b.—Cushman, 1932, Jour. Paleontology, vol. 6, p. 338.—?Morrow, 1934, idem, vol. 8, p. 194, pl. 29, figs. 18a, b.—Cushman, 1936, Geol. Soc. America Bull., vol. 47, p. 418, pl. 1, figs. 8a, b.—Glaessner, 1936, Moscow Univ., Publ. Lab. Paleontology, vol. 1, p. 108, pl. 2, fig. 2.—Cushman, 1938, Cushman Lab. Foram. Research Contr., vol. 14, p. 6, pl. 1, figs. 28–33.
Textilaria globifera Reuss, 1860, Akad. Wiss. Wien, Math.-naturwiss. Kl., Sitzungsber, vol. 40, pl. p. 232, pl. 13, figs. 7, 8.—Egger, 1907, Naturwiss. Ver. Passau, Ber., p. 18, pl. 5, fig. 4.—Egger, 1909, K. bayer. Akad. Wiss., Math.-phys. Kl., Sitzungsber, Jahrg. 1909, 11. Abh., p. 22, pl. 2, fig. 16.—Egger, 1910, Naturwiss.

Ver. Regensburg, Ber., vol. 12, 1907–09, p. 12, pl. 5, fig. 11.—Franke, 1925, Greifswald Univ., Geol.-paleont. Inst., Abh., vol. 6, p. 11, pl. 1, fig. 13.

Gümbelina globifera, Egger, 1899, K. bayer. Akad. Wiss., Math.-naturh. Abt., Abh., Kl. 2, vol. 21, pt. 1, p. 33, pl. 14, figs. 35, 36, 53–55.—Chapman, 1917, W. Australia Geol. Survey Bull. 72, p. 14, pl. 2, fig. 18.—Chapman, 1926, New Zealand Geol. Survey, Paleontology Bull. 11, p. 33, pl. 8, fig. 4.—White, 1929. Jour. Paleontology, vol. 3, p. 35, pl. 4, figs. 9a, b.—Loetterle, 1937, Nebraska Geol. Survey, ser. 2, Bull. 12, p. 34, pl. 5, fig. 3.

Gümbelina pupa White (not Reuss), 1929, Jour. Paleontology, vol. 3, p. 38, pl. 4, fig. 11.

This species ranges throughout beds of Taylor and Navarro ages. It occurs at all seven of the Marlbrook stations.

Genus PSEUDOUVIGERINA Cushman, 1927
PSEUDOUVIGERINA PLUMMERAE Cushman
Plate 53, figure 4

Pseudouvigerina plummerae Cushman, 1927, Cushman Lab. Foram. Research Contr., vol. 3, p. 115, pl. 23, figs. 8a, b.—Cushman, 1931, Tennessee Div. Geology Bull. 41, p. 46, pl. 7, figs. 15, 16.—Sandidge, 1932, Am. Midland Naturalist, vol. 13, p. 197, pl. 19, figs. 9–11.—Cushman, 1936, Geol. Soc. America Bull., vol. 47, p. 419, pl. 1, figs. 13a, b.—Cole, 1938, Florida Geol. Survey, Bull. 16, p. 35 (list), pl. 4, fig. 8.

Most records of this species are from beds of Taylor age but there are a few from the lower part of the Navarro group and upper beds of Austin age. The only specimens found in the Marlbrook marl are from stations 302 and 357.

Family BULIMINIDAE
Genus BULIMINELLA Cushman, 1911
BULIMINELLA CUSHMANI Sandidge
Plate 53, figure 5

Buliminella cushmani Sandidge, 1932, Jour. Paleontology, vol. 6, p. 280, pl. 42, figs. 18, 19.—Cushman and Parker, 1936, Cushman Lab. Foram. Research Contr., vol. 12, p. 8.—Cole, 1938, Florida Geol. Survey Bull. 16, p. 34 (list), pl. 2, fig. 14.

Specimens referable to this species occur at stations 208, 273, 332, and 357.

Genus BULIMINA d'Orbigny, 1826
BULIMINA REUSSI Morrow
Plate 53, figure 6

Bulimina reussi Morrow, 1934, Jour. Paleontology, vol. 8, p. 195, pl. 29, fig. 12.—Cushman and Parker, 1935, Cushman Lab. Foram. Research Contr., vol. 11, p. 99, pl. 15, figs. 8, 10.—Jennings, 1936, Bull. Am. Paleontology, vol. 23, no. 78, p. 31, pl. 3, fig. 20.—Cushman and Hedberg, 1941, Cushman Lab. Foram. Research Contr., vol. 17, p. 95, pl. 22, figs. 30a–c.

Bulimina ovulum Reuss, 1845–46, Verstein. böhm. Kreide, pt. 1, 1845, pl. 8, fig. 57; pl.13, fig. 73 (not *Bulimina ovula* d'Orbigny, 1839).

Bulimina murchisoniana Cushman (not d'Orbigny), 1931, Jour. Paleontology, vol. 5, p. 309, pl. 35, figs. 14a, b.—Cushman, 1932, idem, vol. 6, p. 340.

Most occurrences of this species are in beds of Taylor age but it is present also in the Navarro group and in beds of Austin age. In the Marlbrook marl it occurs at stations 208, 273, 332, and 357.

BULIMINA KICKAPOOENSIS Cole
Plate 53, figure 7

Bulimina kickapoensis Cole, 1938, Florida Geol. Survey Bull. 16, p. 45, pl. 3, fig. 5.—Cushman and Hedberg, 1941, Cushman Lab. Foram. Research Contr., vol. 17, p. 94, pl. 22, figs. 28a–c.

Bulimina elegans Chapman (not d'Orbigny), 1892, Quart. Jour. Geol. Soc., vol. 48, p. 516 (list), pl. 15, fig. 9.—?Egger, 1899, K. bayer. Akad. Wiss., Math.-naturh. Abt., Abh., Kl. 2, vol. 21, pt. 1, p. 50, pl. 15, fig. 44.

Bulimina obtusa Egger (not d'Orbigny), 1899, idem, p. 50, pl. 15, fig. 51.

Bulimina quadrata Cushman and Parker (part) (not Plummer), 1935, Cushman Lab. Foram. Research Contr., vol. 11, p. 100, pl. 15, figs. 13, 14 (not figs. 12, 15, 16).

This species is common in beds of Taylor and Navarro ages. It occurs at all seven Marlbrook stations.

BULIMINA PROLIXA Cushman and Parker
Plate 53, figure 8

Bulimina puschi Cushman (not Reuss), 1931, Tennessee Div. Geology Bull. 41, p. 47, pl. 7, figs. 19a, b.

Bulimina prolixa Cushman and Parker, 1935, Cushman Lab. Foram. Research Contr., vol. 11, p. 98, pl. 15, figs. 5a, b.

This species occurs in upper beds of Taylor age and in the Navarro group. It occurs at station 273 and 302.

Genus NEOBULIMINA Cushman and Wickenden, 1928
NEOBULIMINA CANADENSIS Cushman and Wickenden
Plate 53, figures 9, 10

Neobulimina canadensis Cushman and Wickenden, 1928, Cushman Lab. Foram. Research

Contr., vol. 4, p. 13, pl. 1, figs. 1, 2.—Cushman, 1931, Tennessee Div. Geology, Bull. 41, p. 48, pl. 8, figs. 1a–c.—Cushman, 1933, Cushman Lab. Foram. Research Spec. Publ. 4, pl. 22, figs. 24a, b; Spec. Publ. 5, pl. 27, figs. 15a–c.—Cushman and Parker, 1936, idem, Contr., vol. 12, p. 9, pl. 2, figs. 9, 10.—Jennings, 1936, Bull. Am. Paleontology, vol. 23, no. 78, p. 31, pl. 3, fig. 22.—Albritton and Phleger, 1937, Jour. Paleontology, vol. 11, p. 352.

This species ranges throughout the Upper Cretaceous. In the Marlbrook marl it occurs only at station 332.

Genus VIRGULINA d'Orbigny, 1826
VIRGULINA TEGULATA Reuss
Plate 53, figure 11

Virgulina tegulata Reuss, 1845–46, Verstein. böhm. Kreide, pt. 1, 1845, p. 40, pl. 13, fig. 81.—Cushman, 1937, Cushman Lab. Foram. Research Spec. Publ. 9, p. 4, pl. 1, figs. 8–12.

In America this species ranges from the Eagle Ford shale through beds of Austin and Taylor ages into the lower part of the Navarro group. In the Marlbrook marl it was found only at station 332.

Genus BOLIVINA d'Orbigny, 1839
BOLIVINA INCRASSATA Reuss
Plate 53, figure 12

Bolivina incrassata Reuss, 1851, Haidinger's Naturwiss. Abh., vol. 4, pt. 1, p. 29, pl. 4, figs. 13a, b.—Reuss, 1862, Akad. Wiss. Wien, Math.-naturwiss. Kl., Sitzungsber., vol. 44, pt. 1, 1861, p. 332.—Olszewski, 1875, Sprawozd. Kom. Fizyj. Akad. umiej. Krakowie, vol. 9, p. 123.—Egger, 1899, K. bayer, Akad. Wiss., Math.-naturh. Abt., Abh., Kl. 2, vol. 21, pt. 1, p. 45, pl. 16, figs. 4, 5.—Egger, 1909, K. bayer. Akad. Wiss., Math.-phys. Kl., Jahrg. 1909, 11. Abh., p. 23, pl. 1, fig. 18.—Franke, 1913, Naturh. Ver. preuss. Rheinlande u. Westfalens, Verh., Jahrg. 69, 1912, p. 265.—Franke, 1925, Greifswald Univ., Geol.-paleont. Inst., Abh., vol. 6, p. 21, pl. 2, fig. 8.—Cushman, 1926, Cushman Lab. Foram. Research Contr., vol. 2, pt. 1, p. 19, pl. 2, figs. 1a, b.—Cushman, 1927, idem, vol. 2, pt. 4, p. 86, pl. 12, figs. 1a, b.—Cushman, 1927, Jour. Paleontology, vol. 1, p. 161, pl. 28, figs. 11a, b.—Franke, 1928, Preuss. geol. Landesanstalt, Abh., n. ser., vol. 111, p. 153, pl. 14, fig. 6.—White, 1929, Jour. Paleontology, vol. 3, p. 43, pl. 4, figs. 19a, b.—Cushman, 1931, Tennessee Geol. Survey Bull. 41, p. 49, pl. 8, figs. 2–4.—Cushman, 1931, Jour. Paleontology, vol. 5, p. 310, pl. 35, figs. 17a, b.—Sandidge, 1932, idem, vol. 6, p. 281, pl. 41, fig. 21.—Macfayden, 1932, Geol. Mag., vol. 69, pl. 35, figs. 19a, b.—Cushman and Campbell, 1935, Cushman Lab. Foram. Research Contr., vol. 11, p. 73, pl. 11, fig. 10.—Cushman, 1937, idem, Spec. Publ. 9, p. 38, pl. 5, figs. 19–28.—Cole, 1938, Florida Geol. Survey Bull. 16, p. 35 (list), pl. 3, fig. 1.

Bolivina incrassata lata Egger, 1899, K. bayer. Akad. Wiss., Math.-naturh. Abt., Abh., Kl. 2, vol. 21, pt. 1, p. 46, pl. 16, figs. 8, 9.

Textilaria elongata von Hagenow, 1842, Jahrb. für Min., p. 570.

Bolivina elongata Marsson, 1878, Naturwiss. Ver. Neu-Vorpommern u. Rügen, Mitth., Jahrg. 10, p. 155.

Bolivina primatumida White, 1929, Jour. Paleontology, vol. 3, p. 44, pl. 4, figs. 20a, b.

This species is found throughout beds of Taylor age and in the lower part of the Navarro group. It occurs at stations 208, 273, 302, 337, 341, and 357.

Genus LOXOSTOMUM Ehrenberg, 1854
LOXOSTOMUM PLAITUM (Carsey)
Plate 53, figure 13

Bolivina plaita Carsey, 1926, Texas Univ. Bull. 2612, p. 26, pl. 4, fig. 2.—Berry and Kelley, 1929, U. S. Nat. Mus. Proc., vol. 76, art. 19, p. 4, pl. 1, fig. 14.

Loxostomum plaitum, Cushman, 1931, Tennessee Div. Geology, Bull. 41, p. 51, pl. 8, fig. 9.—Cushman, 1936, Geol. Soc. America Bull., vol. 47, p. 419, pl. 1, figs. 10a, b.

Loxostoma plaitum, Plummer, 1931, Texas Univ. Bull. 3101, p. 182, pl. 10, figs. 5–7.—Sandidge, 1932, Am. Midland Naturalist, vol. 13, p. 363, pl. 31, fig. 22.—Jennings, 1936, Bull. Am. Paleontology, vol. 23, no. 78, p. 31, pl. 3, fig. 23.—Albritton and Phleger, 1937, Jour. Paleontology, vol. 11, p. 352.—Cushman, 1937, Cushman Lab. Foram. Research Spec. Publ. 9, p. 169, pl. 20, figs. 1–4.—Loetterle, 1937, Nebraska Geol. Survey, ser. 2, Bull. 12, p. 61, pl. 11, fig. 1.—Cushman and Hedberg, 1941, Cushman Lab. Foram. Research Contr., vol. 17, p. 95, pl. 23, fig. 1.

This species ranges throughout beds of Taylor and Navarro ages. In the Marlbrook marl it occurs at stations 273 and 341.

Family ELLIPSOIDINIDAE
Genus ELLIPSONODOSARIA A. Silvestri, 1900
ELLIPSONODOSARIA STEPHENSONI Cushman
Plate 53, figures 14–16

Ellipsonodosaria stephensoni Cushman, 1936, Cushman Lab. Foram. Research Contr., vol. 12, p. 52, pl. 9, figs. 10–15.

This species ranges throughout beds of Taylor and Navarro ages. It occurs at stations 273, 332, and 357.

Family ROTALIIDAE
Genus VALVULINERIA Cushman, 1926
VALVULINERIA cf. V. UMBILICATULA (d'Orbigny)
Plate 53, figures 17, 18

Specimens perhaps referable to this species occur at station 208. Similar forms occur in upper beds of Taylor age and in the Navarro group.

Genus GYROIDINA d'Orbigny, 1826
GYROIDINA DEPRESSA (Alth)
Plate 53, figures 19, 20

Rotalina depressa Alth., 1850, Haidinger's Naturwiss. Abh., vol. 3, p. 266, pl. 13, figs. 21a–c.
Gyroidina depressa, Cushman and Church, 1929, California Acad. Sci. Proc., ser. 4, vol. 18, p. 515, pl. 41, figs. 4–6.—Cushman, 1931, Tennessee Div. Geology Bull. 41, p. 54, pl. 9, figs. 7, 8.—Plummer, 1931, Texas Univ. Bull. 3101, p. 190, pl. 13, figs. 3a–c.—Cushman, 1931, Jour. Paleontology, vol. 5, p. 311, pl. 36, figs. 2a–c.—Cushman, 1932, idem, vol. 6, p. 341.—Wickenden, 1932, idem, vol. 6, p. 206, pl. 29, figs. 9a–c.—Sandidge, 1932, idem, vol. 6, p. 283, pl. 43, figs. 16–18.—Cushman and Jarvis, 1932, U. S. Nat. Mus. Proc., vol. 80, art. 14, p. 46, pl. 14, figs. 1a–c.—Albritton and Phleger, 1937, Jour. Paleontology, vol. 11, p. 352.—Loetterle, 1937, Nebraska Geol. Survey, ser. 2, Bull. 12, p. 42, pl. 6, figs. 7a–c.—Cushman and Hedberg, 1941, Cushman Lab. Foram. Research Contr., vol. 17, p. 97, pl. 23, figs. 11, 12.—Cushman and Deaderick, 1942, idem, vol. 18, p. 64, pl. 15, figs. 14–16.
Rotalia cretacea Carsey, 1926, Texas Univ. Bull. 2612, p. 48, pl. 5, figs. 1a, b.
Rotalia beccarii ripleyensis W. Berry, in Berry and Kelley, 1929, U. S. Nat. Mus. Proc., vol. 76, art. 19, p. 15, pl. 3, figs. 10–12.

This species seems to range throughout the American Upper Cretaceous. It occurs at stations 208, 273, 302, 337, 341, and 357.

GYROIDINA GLOBOSA (Hagenow)
Plate 53, figures 21, 22

Nonionina globosa Hagenow, 1842, Neues Jahrb. für Min., p. 574.
Rotalia globosa, Reuss, 1862, Akad. Wiss. Wien, Math.-naturwiss. Kl., Sitzungsber., vol. 44, 1861, p. 330, pl. 7, figs. 2a, b.
Gyroidina globosa, Cushman, 1931, Jour. Paleontology, vol. 5, p. 310, pl. 35, figs. 19a–c.—Cushman and Jarvis, 1932, U. S. Nat. Mus. Proc., vol. 80, art. 14, p. 47, pl. 14, figs. 3, 4.—Cushman and Hedberg, 1941, Cushman Lab. Foram. Research Contr., vol. 17, p. 97, pl. 23, figs. 14a–c.

This species ranges from upper beds of Austin age, through beds of Taylor age, and into lower beds of Navarro age. It occurs at stations 273, 302, and 341.

Family CASSIDULINIDAE
Genus PULVINULINELLA Cushman, 1926
PULVINULINELLA GLABRATA Cushman
Plate 53, figures 23, 24

Pulvinulinella glabrata Cushman, 1938, Cushman Lab. Foram. Research Contr., vol. 14, p. 66, pl. 11, figs. 4a–c.

This species occurs mostly in the Navarro group but has been recorded once from the upper part of the Taylor marl. It occurs in the Marlbrook marl at station 208 only.

Family CHILOSTOMELLIDAE
Genus PULLENIA Parker and Jones, 1862
PULLENIA AMERICANA Cushman
Plate 53, figure 25

Pullenia americana Cushman, 1936, Cushman Lab. Foram. Research Contr., vol. 12, p. 76, pl. 13, figs. 4, 5.—Cushman and Todd, 1943, idem, vol. 19, p. 7, pl. 1, figs. 16a, b.
Pullenia quinqueloba Cushman and Church (not Reuss), 1929, California Acad. Sci. Proc., ser. 4, vol. 18, p. 517, pl. 41, figs. 10, 11.—Cushman, 1931, Tennessee Div. Geology Bull. 41, p. 57, pl. 10, figs. 4a, b.—Cushman, 1931, Jour. Paleontology, vol. 5, p. 313, pl. 36, figs. 3a, b.—Cushman, 1932, idem, vol. 6, p. 342.—Sandidge, 1932, Am. Midland Naturalist, vol. 13, p. 365, pl. 33, figs. 1, 2.

This species ranges through beds of Taylor and Navarro ages. It is common in the Marlbrook marl, occurring at stations 208, 273, 302, 332, 337, and 357.

PULLENIA CORYELLI White
Plate 53, figure 26

Pullenia coryelli White, 1929, Jour. Paleontology, vol. 3, p. 56, pl. 5, figs. 22a, b.—Cushman and Jarvis, 1932, U. S. Nat. Mus. Proc., vol. 80, art. 14, p. 50, pl. 15, figs. 5a, b.—Cushman, 1936, Cushman Lab. Foram. Research Contr., vol. 12, p. 74.—Cushman and Todd, 1943, idem, vol. 19, p. 6, pl. 1, figs. 18a, b.
Pullenia sphaeroides Cushman (not d'Orbigny), 1926, Am. Assoc. Petroleum Geologist Bull., vol. 10, p. 605, pl. 21, figs. 2a, b.
Pullenia quaternaria Cushman (not Reuss), 1931, Jour. Paleontology, vol. 5, p. 313, pl. 36, figs. 4a, b.

All previous records of this species are from the Navarro group or equivalent formations. Typical specimens occur in the Marlbrook marl at stations 273, 302, and 341.

Family GLOBIGERINIDAE
Genus GLOBIGERINA d'Orbigny, 1826
GLOBIGERINA cf. G. CRETACEA d'Orbigny
Plate 53, figure 27

Specimens apparently of this species occur at all seven Marlbrook stations.

Family GLOBOROTALIIDAE
Genus GLOBOTRUNCANA Cushman, 1927
GLOBOTRUNCANA FORNICATA Plummer
Plate 53, figure 28

Globotruncana fornicata Plummer, 1931, Texas Univ. Bull. 3101, p. 198, pl. 13, figs. 4–6.—Sandidge, 1932, Jour. Paleontology, vol. 6, p. 285, pl. 44, figs. 12, 13.—Albritton and Phleger, 1937, idem, vol. 11, p. 353.—Cushman and Hedberg, 1941, Cushman Lab. Foram. Research Contr., vol. 17, p. 99, pl. 23, figs. 18a–c.
Globotruncana convexa Sandidge, 1932, Jour. Paleontology, vol. 6, p. 285, pl. 44, figs. 9–11.

This species ranges through beds of Taylor age into the lower part of the Navarro group. It occurs at all seven stations in the Marlbrook marl.

GLOBOTRUNCANA MARGINATA (Reuss)
Plate 53, figure 29

This species has a wide range in the American Cretaceous from the Eagle Ford shale through beds of Austin and Taylor age, into the lower part of the Navarro group. It occurs at stations 208, 273, 302, 332, and 337.

GLOBOTRUNCANA ARCA (Cushman)
Plate 53, figure 30

Pulvinulina arca Cushman, 1926, Cushman Lab. Foram. Research Contr., vol. 2, pt. 1, p. 23, pl. 3, figs. 1a–c.
Globotruncana arca Cushman, 1927, idem, vol. 3, p. 91, pl. 19, figs. 11a–c.—Cushman, 1927, Jour. Paleontology, vol. 1, p. 169, pl. 28, figs. 15a–c.—Cushman and Church, 1929, California Acad. Sci. Proc., ser. 4, vol. 18, p. 518, pl. 41, figs. 1–3.—Cushman, 1932, Jour. Paleontology, vol. 6, p. 343, pl. 51, figs. 13a–c.—Cushman and Jarvis, 1932, U. S. Nat. Mus., Proc., vol. 80, art. 14, p. 50, pl. 15, figs. 7a–c.—Jennings, 1936, Bull. Am. Paleontology, vol. 23, no. 78, p. 37, pl. 4, figs. 14a, b.—Albritton and Phleger, 1937, Jour. Paleontology, vol. 11, p. 352.—Cole, 1938, Florida Geol. Survey Bull. 16, p. 36 (list), pl. 4, figs. 11, 12.

This species, except for occasional occurrences in the Neylandville marl of the Navarro group, is limited to beds of Taylor age. It occurs in the Marlbrook marl at stations 208, 273, 302, 332, and 357.

Family ANOMALINIDAE
Genus ANOMALINA d'Orbigny, 1826
ANOMALINA NELSONI W. Berry
Plate 53, figure 32

Anomalina nelsoni W. Berry, in Berry and Kelley, 1929, U. S. Nat. Mus., Proc., vol. 76, art. 19, p. 14, pl. 2, figs. 19–21.—Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 27, pl. 5, figs. 1, 2.
Anomalina cf. *A. nelsoni*, Cushman and Hedberg, 1941, idem, vol. 17, p. 99, pl. 23, figs. 20a–c.
Cibicides nelsoni, Plummer, 1936, Texas Univ. Bull. 3501, p. 288, pl. 5, figs. 1–6.

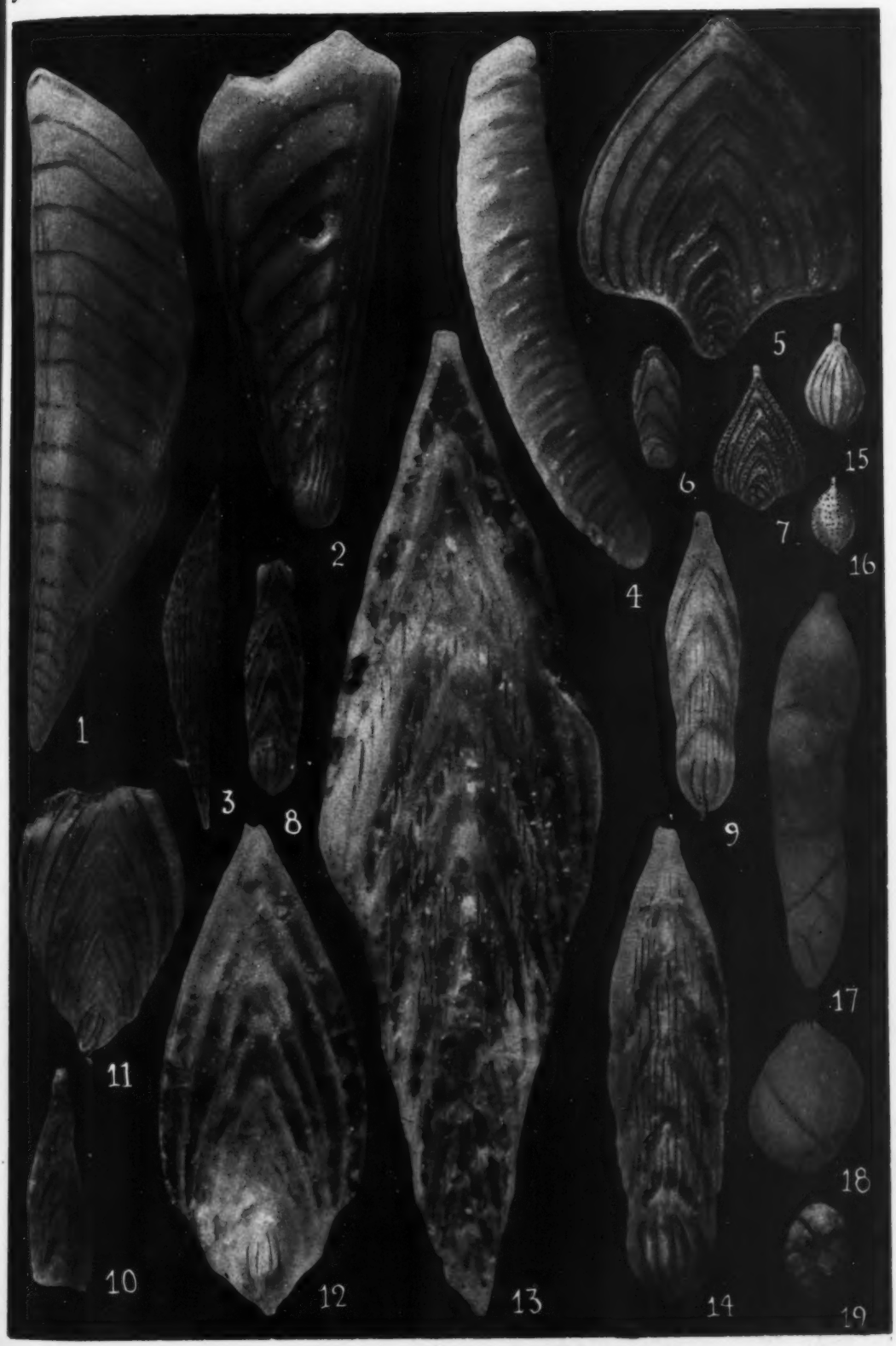
This species ranges through beds of Taylor and Navarro ages. It occurs at stations 208, 273, and 341.

ANOMALINA TENNESSEENSIS W. Berry
Plate 53, figures 33, 34

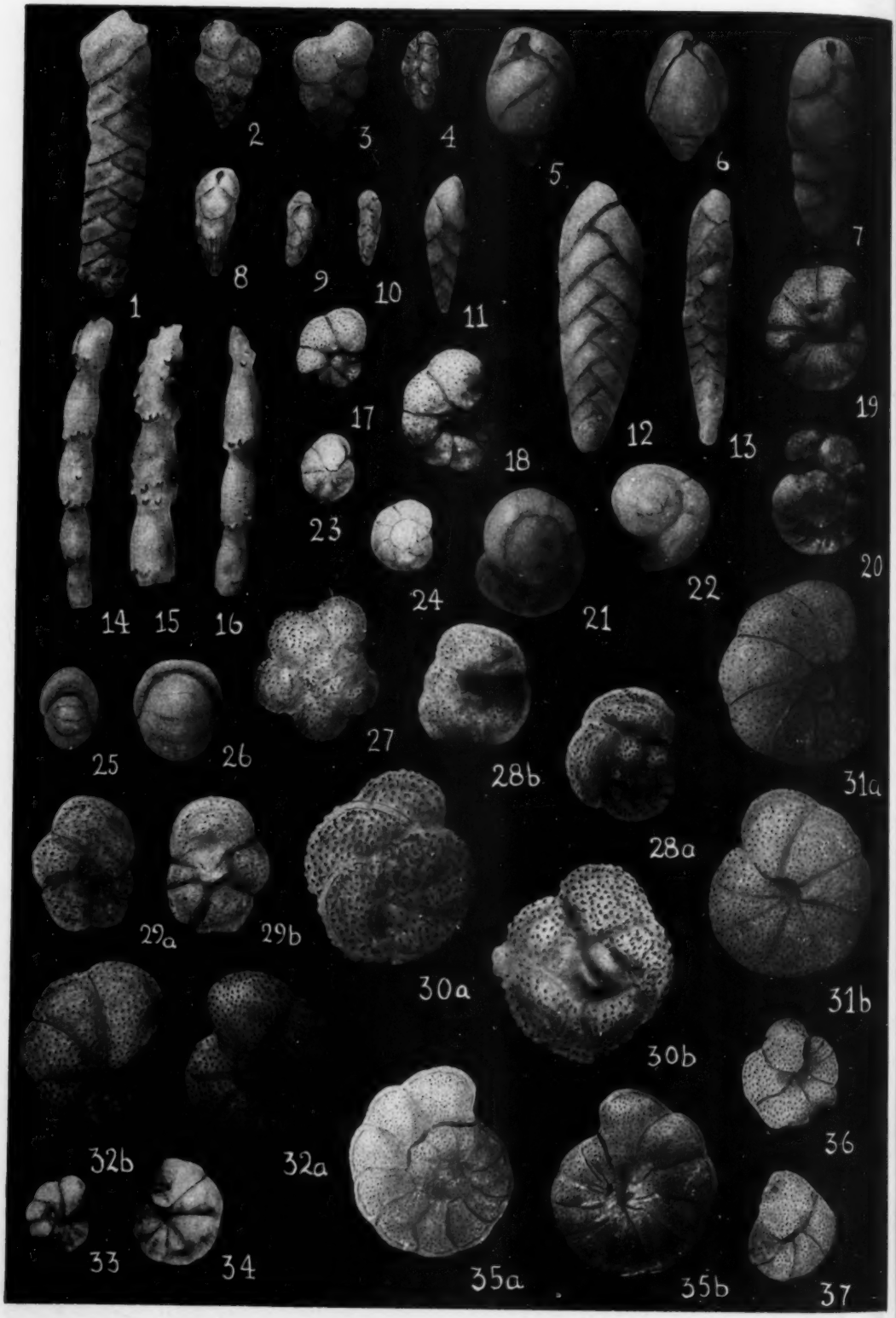
Anomalina tennesseensis W. Berry, in Berry and Kelley, 1929, U. S. Nat. Mus. Proc., vol. 76, art. 19, p. 13, pl. 2, figs. 13–15.—Cushman,

EXPLANATION OF PLATE 52

FIGS. *1, 2*—*Vaginulina wadei* Kelley, sta. 337, 1, ×13; 2, ×24. (p. 334)
3—*Vaginulina multicostata* Cushman, sta. 302, ×24. (p. 334)
4—*Vaginulina taylorana* Cushman, sta. 337, ×24. (p. 334)
5—*Palmula suturalis* (Cushman), sta. 337, ×24. (p. 334)
6—*Palmula primitiva* Cushman, sta. 273, ×24. (p. 335)
7—*Palmula rugosa* (d'Orbigny), sta. 357, ×24. (p. 335)
8, 9—*Frondicularia* cf. *F. linearis* Franke, sta. 332. 8, ×24; 9, ×36. (p. 335)
10—*Frondicularia* cf. *F. frankei* Cushman, sta. 302, ×24. (p. 335)
11, 12—*Frondicularia goldfussi* Reuss, sta. 357, 11, ×24; 12, ×36. (p. 335)
13—*Frondicularia* cf. *F. clarki* Bagg, sta. 337, ×36. (p. 336)
14—*Frondicularia* cf. *F. striatula* Reuss, sta. 357, ×36. (p. 336)
15—*Lagena substriata* Williamson, sta. 273, ×42. (p. 336)
16—*Lagena hispida* Reuss, sta. 273, ×42. (p. 336)
17—*Pyrulina* cf. *P. cylindroides* (Roemer), sta. 357, ×36. (p. 336)
18—*Guttulina* cf. *G. adhaerens* (Olszewski), sta. 208, ×36. (p. 336)
19—*Nonionella austinana* Cushman, sta. 273, ×42. (p. 336)



Cushman and Deadrick—Cretaceous Foraminifera



Cushman and Deadrick—Cretaceous Foraminifera

1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 30, pl. 5, figs. 11a–c.

The only available records are from the Ripley formation of Navarro age in Tennessee and the Selma chalk of Taylor age in Mississippi. It occurs at stations 208, 302. and 357.

ANOMALINA cf. A. RUBIGINOSA Cushman
Plate 53, figure 31

Specimens similar to this species occur at stations 208 and 332.

Genus PLANULINA d'Orbigny, 1826
PLANULINA TAYLORENSIS (Carsey)
Plate 53, figure 35

Anomalina taylorensis Carsey, 1926 (1927), Texas Univ. Bull. 2612, p. 47, pl. 6, figs. 1a, b.
Planulina taylorensis, Cushman, 1931, Tennessee Div. Geology Bull. 41, p. 62, pl. 12, figs. 5a–c. —Cushman, 1931, Jour. Paleontology, vol. 5, p. 341, pl. 36, figs. 6a–c.—Cushman, 1932, idem, vol. 6, p. 345.—Albritton and Phleger, 1937, idem, vol. 11, p. 353.—Loetterle, 1937, Nebraska Geol. Survey, ser. 2, Bull. 12, p. 63, pl. 11, figs. 4a–c.—Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 35, pl. 6, figs. 10a–c.—Cushman and Deaderick, 1942, idem, vol. 18, p. 66, pl. 15, figs. 28–31.

This species is widely distributed and characteristic of beds of Taylor age although it also occurs in the lower part of the Navarro group and in the Brownstown marl of the Austin group. It occurs commonly at all seven Marlbrook stations.

PLANULINA TEXANA Cushman

Planulina texana Cushman, 1938, Cushman Lab. Foram. Research Contr., vol. 14, p. 69, pl. 12, figs. 3a-c.—Cushman, 1940, idem, vol. 16, p. 33, pl. 6, figs. 7a–c.

Most records of this species are from beds of Austin age and the lower part of the Taylor marl. Specimens, seemingly identical, occur at station 273.

Genus CIBICIDES Montfort, 1808
CIBICIDES SUBCARINATUS Cushman and Deaderick, new name

Anomalina coonensis W. Berry (not *Truncatulina coonensis* W. Berry), in Berry and Kelley, 1929, U. S. Nat. Mus. Proc., vol. 76, art. 19, p. 14, pl. 2, figs. 22–24.

EXPLANATION OF PLATE 53

(*a*, dorsal view; *b*, ventral view.)

FIGS. *1*—*Bolivinopsis rosula* (Ehrenberg), sta. 273, ×42. (p. 336)
2, 3—*Gümbelina globulosa* (Ehrenberg), sta. 332, ×42. (p. 336)
4—*Pseudovigerina plummerae* Cushman, sta. 302, ×36. (p. 337)
5—*Buliminella cushmani* Sandidge, sta. 332, ×42. (p. 337)
6—*Bulimina reussi* Morrow, sta. 332, ×42. (p. 337)
7—*Bulimina kickapooensis* Cole, sta. 302, ×42. (p. 337)
8—*Bulimina prolixa* Cushman and Parker, sta. 273, ×42. (p. 337)
9, 10—*Neobulimina canadensis* Cushman and Wickenden, sta. 332, ×36. (p. 337)
11—*Virgulina tegulata* Reuss, sta. 332, ×42. (p. 338)
12—*Bolivina incrassata* Reuss, sta. 302, ×42. (p. 338)
13—*Loxostomum plaitum* (Carsey), sta. 341, ×42. (pl 338)
14–16—*Ellipsonodosaria stephensoni* Cushman, sta. 332, ×42. (p. 338)
17, 18—*Valvulineria* cf. *V. umbilicatula* (d'Orbigny). *17*, Dorsal view; *18*, ventral view, sta. 208, ×36. (p. 339)
19, 20—*Gyroidina depressa* (Alth.) *19*, Ventral view; *20*, dorsal view, sta. 337, ×42. (p. 339)
21, 22—*Gyroidina globosa* (Hagenow). Oblique dorsal views, sta. 273, ×42. (p. 339)
23, 24—*Pulvinulinella glabrata* Cushman. *23*, Ventral view; *24*, dorsal view, sta. 208, ×36. (p. 339)
25—*Pullenia americana* Cushman, sta. 302, ×42. (p. 339)
26—*Pullenia coryelli* White, sta. 273, ×42. (p. 339)
27—*Globigerina* cf. *G. cretacea* d'Orbigny, sta. 302, ×42. (p. 340)
28—*Globotruncana fornicata* Plummer, sta. 337, ×42. (p. 340)
29—*Globotruncana marginata* (Reuss), sta. 302, ×42. (p. 340)
30—*Globotruncana arca* (Cushman), sta. 332, ×42. (p. 340)
31—*Anomalina* cf. *A. rubiginosa* Cushman, sta. 332, ×42. (p. 341)
32—*Anomalina nelsoni* W. Berry, sta. 273, ×42. (p. 340)
33, 34—*Anomalina tennesseensis* W. Berry. *33*, Dorsal view; *34*, ventral view, sta. 302, ×42. (p. 340)
35—*Planulina taylorensis* (Carsey), sta. 337, ×24. (p. 341)
36, 37—*Cibicides beaumontianus* (d'Orbigny), Dorsal views, sta. 208, ×36. (p. 342)

Cibicides coonensis, Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 39, pl. 7, figs. 6–8.—Cushman and Hedberg, 1941, idem, vol. 17, p. 100, pl. 23, figs. 21a–c.

Anomalina pseudopapillosa Cushman (not Carsey), 1931, Tennessee Div. Geology, Bull. 41, p. 61, pl. 12, figs. 4a–c.

As Berry had already proposed *Truncatulina coonensis*, a new name must be selected for this species. It occurs in beds of Taylor and Navarro ages. In the Marlbrook marl it occurs at stations 208 and 357.

CIBICIDES BEAUMONTIANUS (d'Orbigny)
Plate 53, figures 36, 37

Truncatulina beaumontiana d'Orbigny, 1840, Soc. géol. France, Mém., ser. 1, vol. 4, p. 35, pl. 3, figs. 17–19.

Cibicides beaumontiana, Brotzen, 1936, Sveriges geol. undersökning, ser. C, no. 396, p. 188.—Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 39, pl. 7, figs 9a–c.

Cibicides involuta Cushman (not Reuss), 1931, Jour. Paleontology, vol. 5, p. 315, pl. 36, figs. 10a–c.—Cushman, 1932, idem, vol. 6, p. 345.

Nearly all American records of this species are from beds of Taylor age although two are from the Saratoga chalk equivalent to the lower part of the Navarro group. The only specimens found in the Marlbrook marl are from station 208.

JOURNAL OF PALEONTOLOGY, VOL. 18, NO. 4, PP. 343–354, PLS. 54, 55, 2 TEXT FIGS., JULY 1944

SMALLER FORAMINIFERA FROM THE PORTERS CREEK FORMATION (PALEOCENE) OF ILLINOIS

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ABSTRACT—A microfauna of smaller Foraminifera from the cuttings of a water well in Cache, southern Alexander County, shows the occurrence of Lower Eocene (Paleocene) sediments almost to the northern limit of the Mississippi embayment. Six families are represented, comprising 15 genera and 30 species. More than half of the species belong to the Lagenidae, with two to four species in each of the Heterohelicidae, Ellipsoidinidae, Rotaliidae, Globigerinidae, and Anomalinidae. Two new species are described.

INTRODUCTION

THE ORIGINAL northern limit of Tertiary sediments in the Mississippi embayment is unknown. The Cretaceous deposits in the Mississippi Valley probably extended as far north as southeastern Minnesota (Sardeson, 1898) and may have been at one time coextensive with those of the Midcontinent region. To a certain extent the succeeding Paleocene sea flooded the same areas. Therefore it is probable that the earliest Cenozoic formations originally extended farther north than the present outcrops in southern Illinois would indicate. On the other hand, shore line conditions are indicated by the absence of some marine horizons which are present farther south. In Tennessee the Ripley group is composed of the McNairy sand over- and underlain by the Owl Creek and Coon Creek marine formations. The last two formations are not recognized in Kentucky and from the very sandy and glauconitic character of the Ripley in Illinois it is possible that only the McNairy is present here also. The possibility should be pointed out that the shoreward nonfossiliferous phases of these higher and lower formations would take on the sandy characteristics of the McNairy and would therefore be indistinguishable from it.

The same is true of the Wilcox group. In Tennessee it is composed of the Holly Springs sandy formation which is over- and underlain by the Grenada and Ackermann marine shaly and limy formations. The latter is not recognized in Kentucky and from the sandy character of the Wilcox at the northern limit of its outcrop the Grenada is probably also absent. This would leave the Holly Springs as the sole representative of the Wilcox group at the northern end of the embayment, although the possible presence of the sandy shoreward phase of the other members of the group must not be overlooked.

The northernmost outcrop of Paleocene formations shown on the geologic map of the United States (Stose, 1932) is found on the eastern side of the Mississippi embayment just south of the Kentucky line in the north-central part of Henry County, Tennessee. On the west side of the embayment the most northern extent of the Midway is shown southeast of Newport in northeastern White and southeastern Independence counties, Arkansas. However, Lamar and Sutton (1930, fig. 1) mapped the Porters Creek formation around the eastern and northern edges of the embayment across Kentucky and into Alexander County, Illinois, as far west as the town of Unity where the formation dips beneath younger sediments. They also mentioned (p. 953) the possible occurrence of the formation at Idalia and Bloomfield, central Stoddard County, Missouri. However, no correlation of the Porters Creek of Illinois, other than with the formation in Tennessee, was made by these writers. Subsequent work has confirmed the suspected occurrences and revealed others in Missouri (Farrar and McManamy, 1937; Stewart, McManamy, and McQueen, 1943) and has shown that a number of changes are necessary in the Illinois portion of the map (see text fig. 1).

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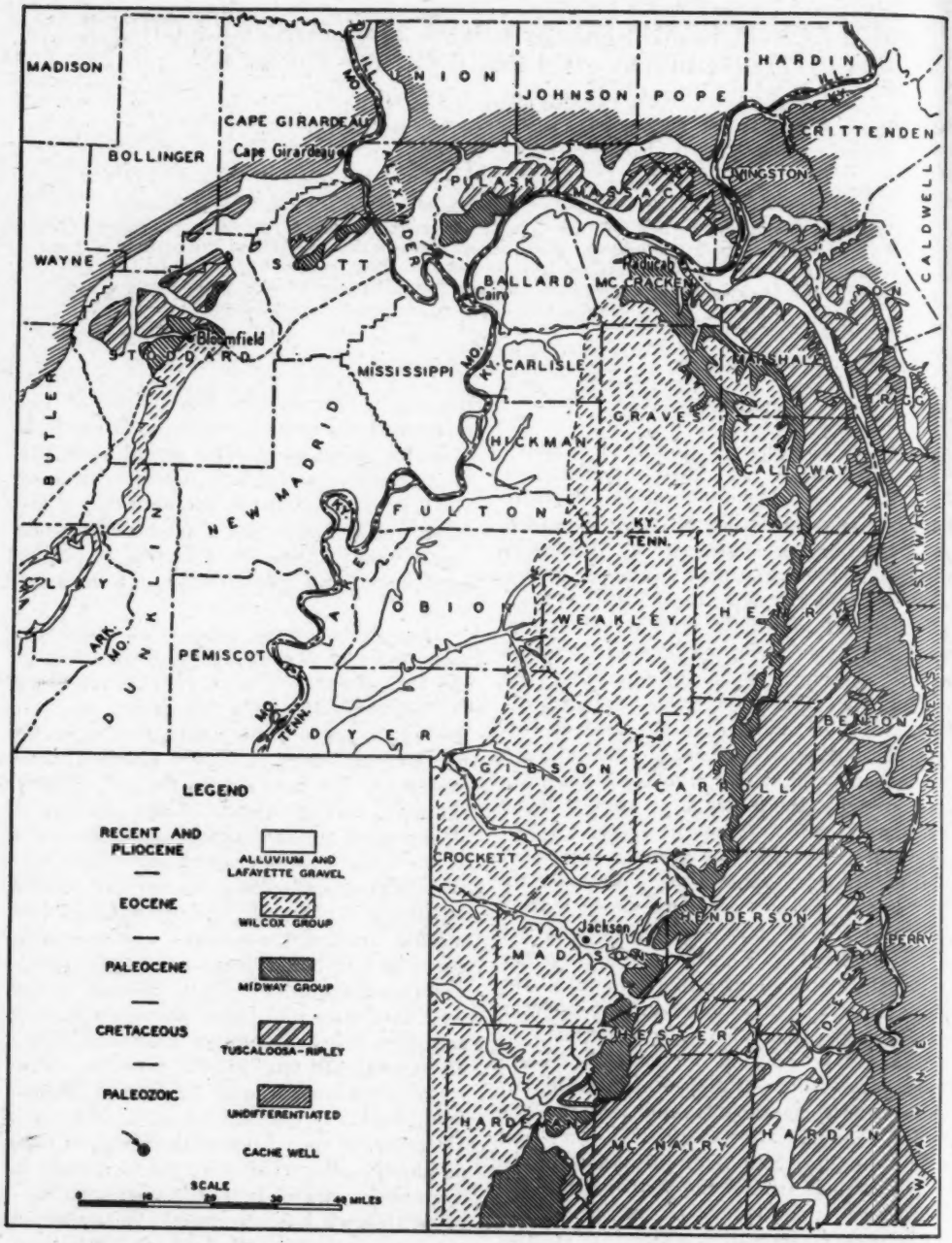

FIG. 1.—Map of the upper part of the Mississippi embayment area showing the outcrop of the Wilcox and Midway groups and the location of the well at Cache, Alexander County, Illinois.

From geologic maps of Tennessee (1923), Kentucky (1929), Illinois (1939), and Missouri (1939, revised by recent work of the Missouri Geological Survey).

The formation containing the fossils described was named the "Porters Creek group" for exposures on Porters Creek, Hardemann County, Tennessee, by Stafford (1864, p. 368) where it has a thickness of 200 to 300 feet. There it overlies the Clayton formation, which together with the Porters Creek, comprises the Midway group of the central and northern embayment areas and underlies the Ackerman formation of Wilcox age. Harris (1896) first correlated the formation with the Midway.

The Cretaceous and Tertiary sediments in the northern part of the embayment in Illinois and Missouri are almost completely devoid of calcareous material and fossil remains, except for an occasional fossil cast. Lamar and Sutton (1930, p. 848) believe the original calcareous material, while once present in the sediments, has been removed by leaching.

The microfauna described was obtained from the cuttings of a water well drilled in 1938 at Cache, Illinois, in SE¼ SE¼ SW¼ sec. 19, T. 16 S., R. 1 W., Alexander County. The well was drilled for O. R. Bourland by E. M. Gould, who furnished a driller's log and 5-foot samples of the drill cuttings to the Subsurface Division of the Illinois State Geological Survey, where they were studied and described by Earl C. Cochrum. It was Mr. Cochrum who called my attention to the occurrence of the numerous Foraminifera found in the samples from a depth of 115 to 135 feet. All but four of the species described came from the two sam-

CORRELATION OF POST-PALEOZOIC SEDIMENTS IN THE UPPER MISSISSIPPI EMBAYMENT AREA

AGE	ARKANSAS	TENNESSEE[1]	KENTUCKY[2]	ILLINOIS	MISSOURI[3]
RECENT AND/OR PLEISTOCENE	Alluvium and Loess	Alluvium and Loess	Alluvium and Loess	Alluvium and Loess	Alluvium and Loess
PLIOCENE	Gravel	Gravel	Lafayette	"Lafayette"	Gravel
EOCENE	Jackson	Jackson	Jackson		
	Claiborne				
	Wilcox	WILCOX: Grenada, Holly Springs, Ackerman	Grenada, Holly Springs	Wilcox	Wilcox
PALEOCENE	Midway	MIDWAY: Porters Creek, Clayton	Porters Creek	Porters Creek	Porters Creek
				Clayton	Clayton
CRETACEOUS	Nacatoch	RIPLEY: Owl Creek, McNairy, Coon Creek	McNairy	RIPLEY: McNairy	RIPLEY: Owl Creek, McNairy, Coon Creek?
		Selma	Selma		Selma (?)
		Eutaw	Eutaw		Eutaw (?)
		Tuscaloosa	Tuscaloosa		

[1] Whitlatch (1940);
[2] McFarlan (1943);
[3] Kansas Geol. Soc. (1939) and Stewart, McManamy, and McQueen (1943).

ples at 120 to 130 feet in depth. A graphic section based on the sample study is shown in text figure 2. The map (fig. 1) is based on the published state geologic maps of Tennessee (1923), Kentucky (1929), Arkansas (1929) and Missouri (1939) and the preliminary edition of the new geologic map of

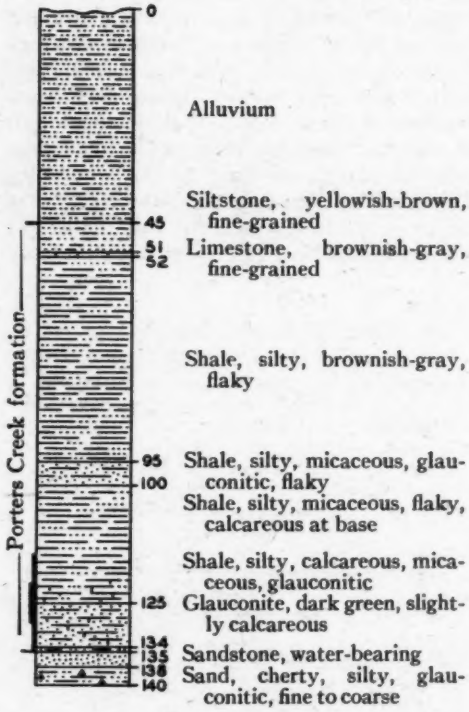

Fig. 2.—Graphic section showing the beds encountered in the Cache well and the fossiliferous zone indicated by the heavy border at the left margin.

Illinois (Weller, 1939), with some modifications in Missouri. Mr. J. E. Lamar contributed to the stratigraphic discussion.

FAUNAL DISCUSSION

The fauna from the Cache well consists of 30 species of the smaller Foraminifera, of which more than half (16 species) belong to the family Lagenidae. This is in accord with conclusions based on studies of Eocene foraminifera by Plummer (1927, p. 12), Cushman (1940), and Toulmin (1941). The other families represented are: Ellipsoidinidae and Anomalinidae, 4 species each; and Heterochilicidae, Rotaliidae, and Globigerinidae, 2 species each. Fifteen genera are represented.

The fauna is distinct from that in the Upper Cretaceous, which can be recognized by its preponderance of Textredariidae and, though very much like that of the Wilcox above, lacks the frequent occurrence of many species of the Miliolidae which characterizes the younger group.

SYSTEMATIC DESCRIPTIONS

Family LAGENIDAE Cushman

Genus CHRYSALIGONIUM Schubert

CHRYSALIGONIUM GRANTI (Plummer)

Plate 54, figures 26, 27

Nodosaria filiformis Carsey, 1926, Texas Univ. Bull. 2612, p. 33, vol. 7, fig. 8; Upper Cretaceous, Texas.

Nodosaria granti Plummer, 1927, Texas Univ. Bull. 2644, p. 83, pl. 5, figs. 9a–d; Midway group, Paleocene, Texas.

Dentalina granti, Plummer, 1931, Texas Univ. Bull. 3101, p. 149, pl. 11, figs. 8, 9; Upper Cretaceous, Texas.—Jennings, 1936, Bull. Am. Paleontology, vol. 23, p. 176, pl. 29, fig. 6; Upper Cretaceous, New Jersey.

Ellipsonodosaria granti, ? Cushman, 1936, Cushman Lab. Foram. Research Contr., vol. 2, p. 151, pl. 9, figs. 3–5; Upper Cretaceous, Texas and Arkansas.—Cushman, 1940, idem, vol. 16, p. 69, pl. 12, fig. 3; Midway group, Paleocene, Alabama.

Chrysaligonium granti, Toulmin, 1941, Jour. Paleontology, vol. 15, p. 589, pl. 79, figs. 34, 35; Salt Mountain limestone, Eocene, Alabama.

Test elongate, slender, slightly arcuate; chambers elongate, cylindrical; wall thick, smooth; suture flush with surface. Diameter of central chamber, 0.16 mm.; length about 0.28 mm.

This form, even though the species is somewhat variable, shows the general characteristics. The fragment (pl. 54, fig. 27) shows the apical spine. Its presence in Upper Cretaceous and lower Wilcox beds make it valueless as an index.

Genus DENTALINA d'Orbigny

DENTALINA cf. D. COMMUNIS (d'Orbigny)

Plate 55, figure 10

Nodosaria (Dentalina) communis d'Orbigny, 1826, Soc. Nat. Sci. Ann., vol. 7, p. 254, no. 35.

Nodosaria communis, Cushman, 1923, U. S. Nat. Mus. Bull. 104, pt. 4, p. 75, pl. 12, figs. 3, 4; Recent, Atlantic.

FAUNAL LIST AND GEOLOGIC RANGE

Species	Pl. fig.	Previous known range
LAGENIDAE		
Chrysaligonium granti (Plummer)	54; 16, 27	Upper Cretaceous—Eocene
Dentalina cf. *D. communis* (d'Orbigny)	55; 20	Eocene—Recent
Dentalina cf. *D. cooperensis* Cushman	54; 21	Eocene
Dentalina pauperata d'Orbigny	54; 10	Jurassic–Recent?
Dentalina spira Cooper, n. sp.	54; 1, 2	
Lagena laevis (Montagu)	54; 6, 7	Eocene–Recent
Nodosaria latejugata Gümbel	55; 24, 25	Eocene–Oligocene
Nodosaria spinocostata Cooper, n. sp.	54; 11	
Nodosaria cf. *N. vertebralis* (Batsch)	55; 14, 15	Cretaceous–Recent
Nodosaria cf. *N. zippei* Reuss	55; 18, 19	Cretaceous
Palmula meglameryae Toulmin	55; 20, 21	Paleocene–Eocene
Robulus inornatus (d'Orbigny)	55; 26, 27	Eocene–Miocene
Robulus magnificus Toulmin	55; 1, 2	Eocene
Robulus midwayensis (Plummer)	55; 22, 23	Paleocene–Eocene
Vaginulina gracilis Plummer	55; 5, 6	Paleocene
Vaginulina robusta Plummer	55; 16, 17	Paleocene
HETEROHELICIDAE		
Rectogümbelina alabamensis Cushman	55; 3, 4	Paleocene
Siphonogeneroides? eleganta (Plummer)	54; 14	Paleocene
ELLIPSOIDINIDAE		
Ellipsonodosaria lepidula (Schwager)	54; 23	Upper Cretaceous–Pliocene
Ellipsonodosaria plummerae Cushman	54; 18, 19	Paleocene
Ellipsonodasaria sagrinensis (Bagg)	54; 22	Paleocene–Pliocene
Ellipsonodosaria spinulosa (Plummer)	54; 20	Paleocene
ROTALIIDAE		
Eponides exigua limbata (Plummer)	55; 11–13	Paleocene
Siphonia prima Plummer	55; 7–9	Cretaceous–Paleocene
GLOBIGERINIDAE		
Globigerina compressa Plummer	54; 8, 9	Paleocene–Eocene
Globigerina triloculinoides Plummer	54; 12, 13	Paleocene–Eocene
ANOMALINIDAE		
Anomalina acuta Plummer	54; 3–5	Paleocene–Eocene
Anomalina midwayensis (Plummer)	54; 15–17	Paleocene
Cibicides alleni (Plummer)	54; 24, 25	Cretaceous–Paleocene
Cibicides vulgaris (Plummer)	54; 28, 29	Paleocene

Dentalina communis, Howe and Wallace, 1932, Louisiana Dept. Cons. Geol. Bull. 2, p. 24, pl. 6, fig. 8; Upper Eocene, Louisiana.—?Cushman and Garrett, 1932, Cushman Lab. Foram. Research Contr., vol. 8, p. 55, pl. 7, figs. 12, 13; Wilcox group, Eocene, Alabama.—?Cushman and Garrett, 1939, Cushman Lab. Foram. Research Contr., vol. 15, p. 80, pl. 14, figs. 1–3; Wilcox group, Eocene, Alabama.—Toulmin, 1941, Jour. Paleontology, vol. 15, p. 584, pl. 79, fig. 13; Salt Mountain limestone, Alabama.

Test elongate, slightly tapered, almost straight; sutures somewhat indistinct, inclined to axis; average diameter, 0.13 mm.; length (5 chambers), 0.39 mm.

This fragment is referred to this common Wilcox species with some doubt. It is not recorded in the Midway of Texas or Alabama.

DENTALINA cf. D. COOPERENSIS Cushman
Plate 54, figure 21

Dentalina cooperensis Cushman, 1933, Cushman Lab. Foram. Research Contr., vol. 9, p. 8, pl. 1, fig. 17; Upper Jackson, Eocene, southeastern Coastal Plain.—Cushman, 1935, U. S. Geol. Survey Prof. Paper 181, p. 20, pl. 8, figs. 3, 4; Eocene, Southeastern United States.

Test elongate, compressed, somewhat tapered, gently curved, apical end slightly pointed; sutures distinct, only very slightly oblique to axis; wall smooth; apical end pointed; diameter, 0.10 mm., length (6 chambers), 0.45 mm.

This specimen, like that of *D. communis*, is of doubtful affinity and is questionably referred to this species.

DENTALIA cf. D. PAUPERATA d'Orbigny
Plate 54, figure 10

Dentalina pauperata d'Orbigny, 1846, Foram. Foss. Vienne, p. 46, pl. 1, figs. 57, 58.—Bornemann, 1855, Zeit. deutsch. geol. Gesell., vol. 7, p. 324, pl. 13, fig. 7.—Sherborn and Chapman, 1886, Roy. Micr. Soc. Jour., p. 750, pl. 15, fig. 9.—Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 58, pl. 10, fig. 15; Midway group, Paleocene, Alabama.

Nodosaria pauperata, H. B. Brady, 1884, Challenger, vol. 9 (zool.), p. 500, text fig. 14.—Chapman, 1893, Roy, Micr. Soc. Jour., p. 588, pl. 8, fig. 32.—Cushman, 1913, U. S. Nat. Mus. Bull. 71, pt. 3, p. 51, pl. 25, fig. 7.—Halkyard, 1917, Proc. Manchester Lit. Phil. Soc. Mem., vol. 62, no. 6, p. 71, pl. 4, figs. 8, 9.—Cushman, 1923, U. S. Nat. Mus. Bull. 104, pt. 4, p. 72, pl. 14, fig. 13.—Plummer, 1927, Texas Univ. Bull. 2644, p. 79, pl. 4, fig. 11; Midway group, Paleocene, Texas.

Test elongate, slightly tapered; chambers slightly arcuate, short, wide; initial chamber narrower, longer than those above, with terminal spine; walls smooth; sutures fairly prominent, transverse; average diameter, 0.33 mm.

This long ranged species, abundant in the Midway of Texas and Alabama, has no value as a marker.

DENTALINA SPIRA Cooper, n. sp.
Plate 54, figures 1, 2

Chambers globular, almost spherical; surface marked by 14 wide prominent ribs, some of which may not continue over entire length of chamber, tapering and merging with shell surface near sutures; somewhat spiral in arrangement when viewed from above; diameter, 1.25 mm.; height (one chamber), 1.2 mm.

D. spira does not appear to conform to any known species of *Dentalina* in the character and spiral arrangement of the ribs.

Genus LAGENA Walker and Jacob
LAGENA LAEVIS (Montagu)
Plate 54, figures 6, 7

Serpula (Lagena) laevis ovalis Walker and Boys, 1784, Test. Min. p. 3, pl. 1, fig. 9.

Vermiculum laeve, Montagu, 1803, Test. Brit., p. 524.

Lagena laevis, Cushman, 1913, U. S. Nat. Mus. Bull. 71, pt. 3, p. 5, pl. 1, fig. 3, pl. 38, fig. 5; Recent, Pacific.—Howe, 1939, Louisiana Dept. Cons. Geol. Bull. 14, p. 50, pl. 6, fig. 12; Claiborne group, Eocene, Louisiana.—Toulmin, 1941, Jour. Paleontology, vol. 15, p. 593, pl. 80, fig. 7; Salt Mountain limestone, Eocene, Alabama.

Test almost globular, slightly elliptical in lateral view; neck cylindrical, set abruptly on chamber; wall smooth; diameter 0.40 mm., length, probably 0.60–0.70 mm.

Although not known from the Cretaceous, this species ranges throughout the Tertiary.

Genus NODOSARIA Lamark
NODOSARIA LATEJUGATA Gümbel
Plate 55, figures 24, 25

Nodosaria latejugata Gumbel, 1870, K. bayer. Akad. Wiss. München, Cl. 2, Abh., vol. 10,

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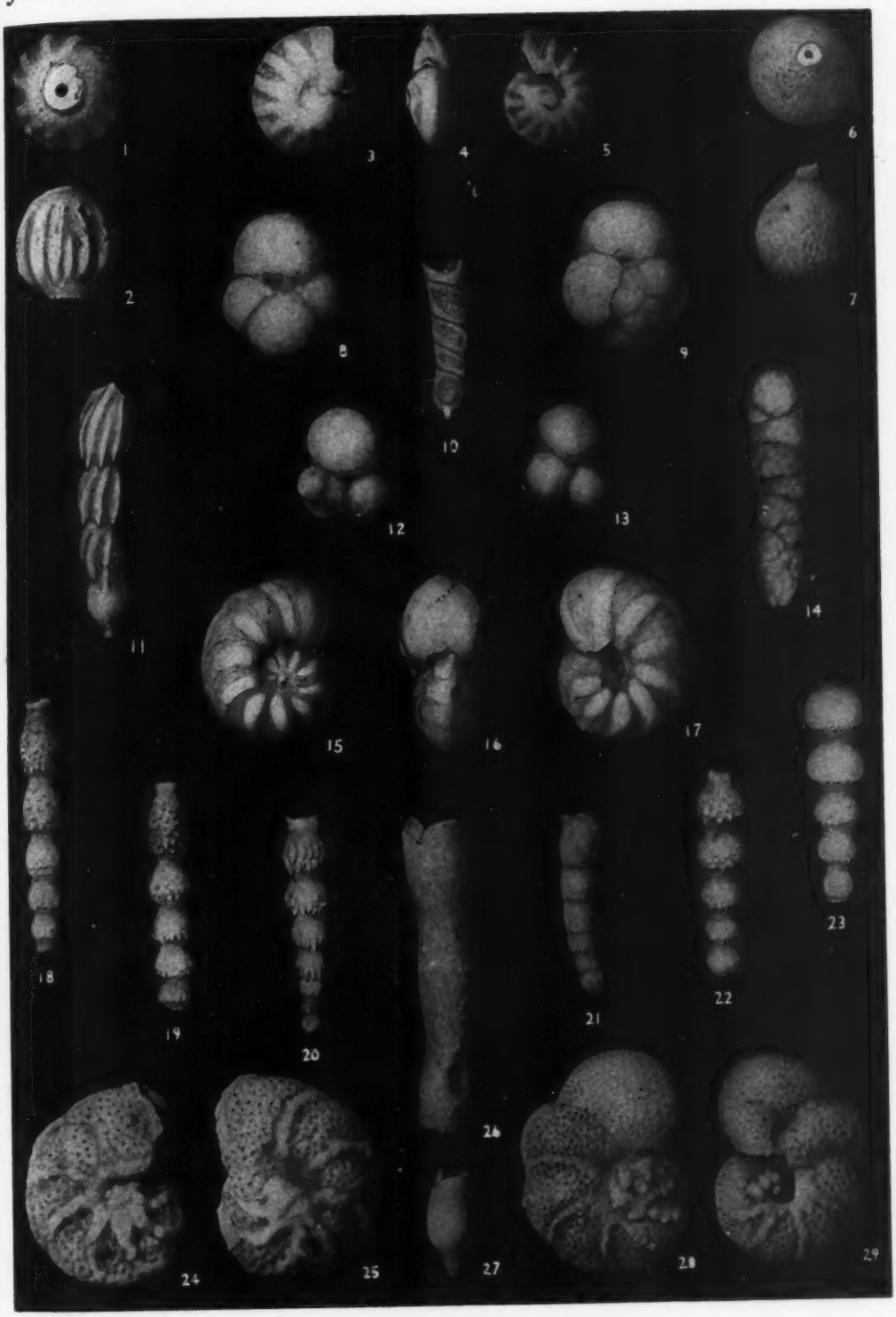
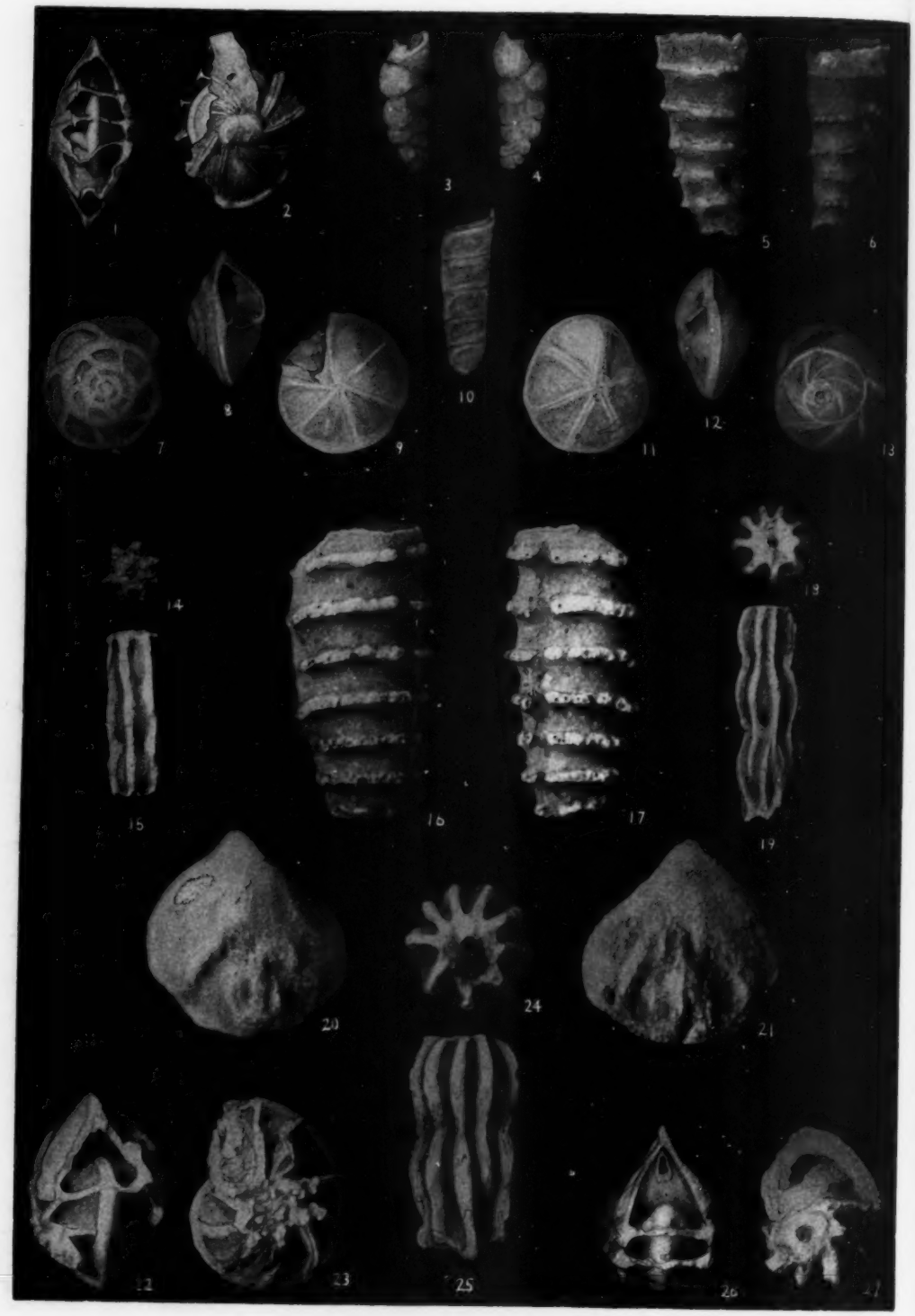
EXPLANATION OF PLATE 54

FIGS. *1, 2—Dentalina spira* Cooper, n. sp. *1*, Sideview; *2*, top view, ×20. (p. 348)
3–5—Anomalina acuta Plummer. *3*, Ventral view; *4*, peripheral view; *5*, dorsal view, ×90. (p. 353)
6, 7—Lagena laevis (Montagu). *6*, Apertural view; *7*, lateral view, ×60. (p. 348)
8, 9—Globigerina compressa Plummer. *8*, Ventral view; dorsal view, ×90. (p. 353)
10—Dentalina cf. *D. pauperata* d'Orbigny, ×90. (p. 348)
11—Nodosaria spinocostata Cooper, n. sp., ×60. (p. 349)
12, 13—Globigerina triloculinoides Plummer, ×90 (p. 353)
14—Siphonogeneroides? eleganta Plummer, ×90. (p. 351)
15–17—Anomalina midwayensis (Plummer). *15*, Dorsal view; *16*, peripheral view; *17*, ventral view, ×90. (p. 354)
18, 19—Ellipsonodosaria plummerae Cushman. ×90. (p. 352)
20—Ellipsonodosaria spinulosa (Plummer). ×90. (p. 352)
21—Dentalina cf. *D. cooperensis* Cushman. ×90. (p. 347)
22—Ellipsonodosaria saginensis (Plummer). ×90. (p. 352)
23—Ellipsonodosaria lepidula (Schwager). ×90. (p. 352)
24, 25—Cibicides alleni (Plummer). *24*, Ventral view; *25*, dorsal view. ×60. (p. 354)
26, 27—Chrysaligonium granti (Plummer). ×90. (p. 346)
28, 29—Cibicides vulgaris (Plummer). *28*, Dorsal view; *29*, ventral view. ×60. (p. 354)



Cooper—Paleocene Foraminifera



Cooper—Paleocene Foraminifera

p. 619, pl. 1, fig. 32; Upper Eocene, Bavaria.—Hankten, 1876, Magy. kir. földt. int. Évköuyoe, vol. 4, p. 21, pl. 2, figs. 6a–d; Eocene, Alabama.—Cushman, 1925, Cushman Lab. Foram. Research Contr., vol. 1, p. 66, pl. 10, fig. 7; Eocene, Alabama.—Cushman and Hanna, 1927, San Diego Soc. Nat. Hist. Trans., vol. 5, no. 4, p. 52, pl. 5, figs. 1–3; LaJolla formation, Eocene, California.—Cushman, 1935, U. S. Geol. Survey Prof. Paper 181, p. 21; Upper Eocene, U. S. Coastal Plain.—Cushman and McMasters, 1936, Jour. Paleontology, vol. 10, p. 512, pl. 75, figs. 11, 12; Middle Eocene, California.—Toulmin, 1941, Jour. Paleontology, vol. 15, p. 588, pl. 79, figs. 26, 27; Salt Mountain limestone, Eocene, Alabama.

Nodosaria affinis Plummer, 1927, Texas Univ. Bull. 2644, p. 89, pl. 14, figs. 2a–d; Midway group, Paleocene, Texas.—Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 59, pl. 10, figs. 30–33; Midway group, Paleocene, Alabama.

Nodosaria burdensis Hankten, 1876, Magy. kir. földt. int. Évköuyoe, vol. 4, p. 23, pl. 2, fig. 10, pl. 16, fig. 4.

Nodosaria vertebralis Nuttall, 1932, Jour. Paleontology, vol. 6, p. 15, pl. 3, fig. 9; Alazan shale, Lower Oligocene, Tampico Embayment, Mexico.

Nodosaria sp. A, Israelsky, 1939, Sixth Pacific Sci. Cong. Proc. vol. 2, p. 575, pl. 3, fig. 11; Marysville formation, Eocene, California.

Test straight; chambers broad, only slightly inflated; with 9 strong longitudinal costate which continue across sutures and are normal to surface of chamber; sutures transverse; diameter 1.2 mm.; length (2 chambers), 2.0 mm.

This very strongly ribbed form seems quite variable in its specific characters. The fragmentary specimen figures represents one of the largest assigned to this species although it has the minimum number of costae. It is very common in Eocene sediments, especially in the lower formations. While quite similar to the Cretaceous *N. zippei* Reuss it differs from *N. affinis* Reuss, which has according to the original description only 4 to 5 costae.

NODOSARIA SPINOCOSTATA Cooper, n. sp.
Plate 54, figure 11

Nodosaria spinulosa Plummer (part), 1927, Texas Univ. Bull. 2644, p. 84, pl. 4, fig. 19c only; Midway group, Paleocene, Texas.

Ellipsonodosaria alexanderi, Cushman (part), 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 69, pl. 11, figs. 27, 29 only; Midway group, Paleocene, Texas.

Test elongate, slightly curved; chambers elongate to globular, increasing in size and length upward; initial chamber smaller than one next above, free of costae, terminated by relatively large spine; costae on succeeding chambers nine or less, discontinuous, each terminating in spine overhanging constricted region of sutures; average diameter, 0.20 mm.; length (3 chambers), 0.75 mm.

This species differs from *N. spinulosa* (Montagu) of various authors and *E. alexanderi* Cushman in that it is regularly costate as in *N. latejugata* Gümbel and others of this type, but the costae of *N. spinocostata* end in spines as shown by Plummer (1927, p. 4, fig. 19c) and Cushman (1940, pl. 11, figs. 27, 29). The holotype of *E. alexanderi* Cushman (1936, pl. 9, fig. 9) shows the characteristically irregular distribution of the spines over the entire surface of the chamber wall.

EXPLANATION OF PLATE 55

FIGS. *1, 2—Robulus magnificus* Toulmin. *1*, Peripheral view; *2*, dorsal view. ×20. (p. 350)

3, 4—Rectogümbelina alabamensis Cushman. ×90. (p. 351)

5, 6—Vaginulina gracilis Plummer. ×60. (p. 351)

7–9—Siphonia prima Plummer. *7*, Dorsal view; *8*, peripheral view; *9*, ventral view. ×90. (p. 353)

10—Dentalina cf. *D. communis* (d'Orbigny). ×90. (p. 346)

11–13—Eponides exigna limbata Plummer. *11*, Ventral view; *12*, peripheral view; *13*, dorsal view. ×90. (p. 353)

14, 15—Nodosaria cf. *N. vertebralis* (Batsch). *1*, Top view of broken specimen; *2*, lateral view of three chambers. ×20. (p. 350)

16, 17—Vaginulina robusta Plummer. Opposite sides of one specimen. ×40. (p. 351)

18, 19—Nodosaria zippei Reuss. Top and lateral views. ×20. (p. 350)

20, 21—Palmula mcglamerae Toulmin. Opposite views of one specimen. ×40. (p. 350)

22–23—Robulus midwayensis (Plummer). *22*, Peripheral view; *23*, dorsal view. ×40. (p. 351)

24–25—Nodosaria latejugata Gümbel. *24*, Top view, broken along suture; *25*, lateral view. ×20. (p. 348)

26–27—Robulus inornatus (d'Orbigny). *26*, Peripheral view of broken shell showing the oval, slit-like aperature; *27*, dorsal view. ×40. (p. 350)

NODOSARIA cf. N. VERTEBRALIS (Batsch)
Plate 55, figures 14, 15

Nautilus (*Orthoceras*) *vertebralis* Batsch, 1791, Conch. des Seesandes no. 6, p. 3, pl. 2, fig. 6; Recent, Mediterranean.

Nodosaria vertebralis, H. B. Brady, 1884, Challenger, vol. 9 (Zool.), p. 514, pl. 63, fig. 35; pl. 64, figs. 11–14; Recent.—Flint, 1899, U. S. Nat. Mus. Ann. Rept. for 1897, p. 312, pl. 57, fig. 5; Recent.—Bagg, 1912, U. S. Geol. Survey Bull. 513, p. 60, pl. 17, fig. 2; Pliocene and Pleistocene, California.—Cushman, 1913, U. S. Nat. Mus. Bull. 71, pt. 3, p. 60, pl. 32, fig. 1; Recent, North Pacific.—Cushman, 1919, Carnegie Inst. Washington Pub. 291, p. 35, pl. 7, figs. 3–5; Recent, Caribbean and tropical Pacific, West Indies.—Cushman, 1919, U. S. Nat. Mus. Bull. 100, vol. 4, p. 211, pl. 38, figs. 2, 3; pl. 40, fig. 2; Recent, Philippine Archipelago.—Cushman, 1923, idem., Bull. 104, pt. 4, p. 86, pl. 14, fig. 6; Recent, Gulf of Mexico.—Plummer, 1927, Texas Univ. Bull. 2644, p. 88, pl. 5, fig. 10; Midway group, Paleocene, Texas.

This fragment showing three chambers seems closest to *N. vertebralis* by reason of the few continuous ribs and the almost total lack of inflation of the valves. It is common in the lower Midway of Texas but the species is known to range from the Cretaceous to Recent.

NODOSARIA cf. N. ZIPPEI Reuss
Plate 55, figures 18, 19

Nodosaria zippei Reuss, 1844, Geogn. Skizze aus Böhmer, p. 210.—Reuss, 1845, Die Versteinerungen der böhemischen Kreide, pt. 1, p. 25, pl. 8, figs. 1–3; Cretaceous, Bohemia.—Beissel and Halzapfel, 1891, Abh. d. geol. Landesanstalt, n. ser., no. 3, pt. 6, pp. 31, 32, figs. 10–29, pl. 16, fig. 32.—Egger, 1899, Abh. d. II, Ck. d. k. Ak. d. Wiss, vol. 21, pt. 1, p. 78, pl. 8, fig. 3.—Plummer, 1931, Texas Univ. Bull. 3101, p. 157; Cretaceous, Texas.—Sandidge, 1932, Jour. Paleontology, vol. 6, p. 275, pl. 42, figs. 13, 14; Ripley formation, Cretaceous, Texas.—Jennings, 1936, Bull. Am. Paleontology, vol. 23, p. 178, pl. 2, fig. 13. Navisink formation, Cretaceous, New Jersey.

Test elongate, straight; chambers numerous; globular, separated by prominent, deeply incised, transverse sutures; ribs 9, raised, fin-like, rarely fused, more frequently abruptly terminated; diameter, 0.8 mm.; length (2 chambers), 0.17 mm.

The specimen illustrated has been referred to this species because of the joining or fusing of some costae and the termination of others; both features are shown in figure 19. This specimen is classified with *N. zippei* with some hesitancy because all other described forms are from the Cretaceous.

Genus PALMULA Lea
PALMULA MCGLAMERYAE Toulmin
Plate 55, figures 20, 21

Palmula mcglameryae Toulmin, 1941, Jour. Palaeontology, vol. 15, p. 592, pl. 80, figs. 1–3; Salt Mountain limestone, Eocene, Alabama.

Polymorphina cushmani Plummer, 1927, Texas Univ. Bull. 2644, p. 125, pl. 6, fig. 9.

Test wide, compressed, thickest through rounded base; periphery irregular or asymmetric, rounded on basal margin, produced to point on aperatural end; width, 1.1 mm.; height, 1.2 mm.

Although the distal end is more rounded than the form illustrated by Plummer, Toulmin (1941) in his three figures and in his remarks demonstrates the great variability of the outline of this species.

Genus ROBULUS Montfort
ROBULUS INORNATUS (d'Orbigny)
Plate 55, figures 26, 27

Robulina inornata d'Orbigny, 1846, Foram. Foss. Bass. Tert. Vienne, p. 102, pl. 4, figs. 25, 26; Miocene, Austria.

Cristellaria inornata, Cushman and Hanna, 1927, California Acad. Sci. Proc., ser. 4, vol. 16, p. 217, pl. 14, fig. 5; Eocene, California.—Nuttall, 1932, Jour. Paleontology, vol. 6, p. 10; Eocene, Mexico.—Palmer and Bermúdez, 1936, Soc. Cubana Hist. Nat. Mem., vol. 10, no. 4, p. 249; Oligocene, Cuba.

Robulus inornatus, Cushman and Backsdale, 1930, Stanford Univ. Dept. Geol. Contr., vol. 1, no. 2, p. 62, pl. 11, figs. 2, 3; Eocene, California.—?Israelsky, 1939, Proc. Sixth Pacific Sci. Cong., p. 573, pl. 3, fig. 1; Marysville formation (Capay stage), Eocene, California.—Toulmin, 1941, Jour. Paleontology, vol. 15, p. 577, pl. 78, fig. 19, text fig. 2B; Salt Mountain limestone, Eocene, Alabama.

Test large, somewhat compressed, thickness three-fourths of diameter, closely coiled, periphery acutely keeled; chambers 7 in last whorl, triangular in outline, increasing rapidly in size to final one; sutures distinctly limbate, slightly curved, tangent to large umbo; diameter, 1.0 mm.; thickness, 0.75 mm.

ROBULUS MAGNIFICUS Toulmin
Plate 55, figures 1, 2

Robulus magnificus Toulmin, 1941, Jour. Paleontology, vol. 15, p. 578, pl. 78, fig. 22, text fig.

2D; Salt Mountain limestone, Eocene, Alabama.

Test compressed, thickness about one-half of diameter; periphery distinctly keeled in early chambers, less so in final ones; chambers 9 in last whorl; sutures almost straight to slightly curved, raised, distinctly limbate, subtangent to, but not meeting umbo in final two or three chambers; diameter, 2.0 mm.; thickness, 1.1 mm.

This form seems identical with *R. magnificus* described by Toulmin from Alabama, except that the sutures of the Illinois specimen are somewhat less curved.

ROBULUS MIDWAYENSIS (Plummer)
Plate 55, figures 22, 23

Cristellaria midwayensis Plummer, 1927, Texas Univ. Bull. 2644, p. 95, pl. 13, figs. 5a–c; Midway group. Paleocene, Texas.
Lenticulina midwayana Israelsky, 1939, Proc. Sixth Pacific Sci. Cong., p. 573, pl. 2, figs. 7, 8; Marysville formation (Capay stage), Eocene, California.
Robulus midwayensis Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 54, pl. 9, fig. 12; Midway group, Paleocene, Alabama.—Toulmin, 1941, Jour. Paleontology, vol. 15, p. 579, pl. 78, fig. 23, text fig. 2G; Salt Mountain limestone, Eocene, Alabama.

Test large, only slightly compressed, diameter and thickness about equal; chambers 9 in last whorl; slightly curved, almost equal in size, increasing very gradually to final chamber; sutures prominent, limbate, tapering, with greatest curvature near peripheral margin; diameter and thickness, about 1.2 mm.

The Illinois specimen is nodose and thus resembles the Texas form but Salt Mountain specimens have a smooth umbo. This species is a good Midway marker in Texas.

Genus VAGINULINA d'Orbigny
VAGINULINA GRACILIS Plummer
Plate 55, figures 5, 6

Vagulina gracilis Plummer, 1927, Texas Univ. Bull. 2644, p. 111, pl. 6, figs. 5a–b; Midway group, Paleocene, Texas.—Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 61, pl. 9, fig. 27; Midway group, Paleocene, Alabama.

Test tapering, slightly arcuate, compressed; chambers short; sutures only slightly oblique, marked by abrupt, narrow, somewhat nodose and discontinuous ridges; diameter, average, 0.3 mm; height, 5 chambers, 0.50 mm.

This species is common in the lower Midway of Alabama and Texas, where it is succeeded in the upper Midway by *V. robusta* Plummer.

VAGINULINA ROBUSTA Plummer
Plate 55, figures 16, 17

Vaginulina robusta Plummer, 1927, Texas Univ. Bull. 2644, p. 112, pl. 6, figs. 4a–b, pl. 13, fig. 3; Midway group, Paleocene, Texas.—Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 61, pl. 10, figs. 1–4; Midway group, Paleocene, Alabama.

Test, large, robust, slightly compressed; straight; chambers smooth, short but quite broad; sutures transverse to slightly oblique, prominent, somewhat nodose; nodes discontinuous along more convex edges (in double row on broader edge, see figs. 16, 17); average diameter, 0.8 mm; height, 5 chambers, 1.3 mm.

This species is characteristic of the upper Midway in Texas and Alabama. It is straighter and more robust than *V. gracilis*.

Family HETEROHELICIDAE Cushman
Genus RECTOGÜMBELINA Cushman
RECTOGÜMBELINA ALABAMENSIS Cushman
Plate 55, figures 3, 4

Rectogümbelina alabamensis Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 65, pl. 11, fig. 16; Midway group, Paleocene, Alabama.

Test very small, slightly arcuate, slender, tapering; early chambers biserial, later ones uniserial, biserial chambers less inflated; early sutures slightly and less depressed than later ones; diameter 0.065–0.145 mm.; length, 0.37.

Although slightly larger than the form described by Cushman from Alabama, the Illinois specimen seems to conform in all other respects. Common in the upper Midway of Alabama.

Genus SIPHONOGENEROIDES Cushman
SIPHONOGENEROIDES? ELEGANTA (Plummer)
Plate 54, figure 14

Siphonogenerina eleganta Plummer, 1927, Texas Univ. Bull. 2644, p. 126, pl. 8, figs. 1a–c; Midway group, Paleocene, Texas.—Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 66, pl. 11, fig. 17; Midway group, Paleocene, Alabama.

Test small, elongate, straight, tapering; early chambers indistinct, may be bi- or triserial, later chambers irregular in size and shape, arranged alternately in oblique manner; sutures distinct, sharply incised; aperature terminal; diameter, 0.072–0.15 mm.; length, 0.50 mm.

This species, which is placed in synonymy with *Siphogenerina eleganta* Plummer by Cushman, is described as biserial by Plummer and triserial by Cushman. The early chambers of the Illinois specimen are too indistinct for accurate determination. It is common in the upper Midway of Texas and the lower Midway of Alabama.

Family ELLIPSOIDINIDAE
Genus ELLIPSONODOSARIA A. Silvestri
ELLIPSONODOSARIA LEPIDULA (Schwager)
Plate 54, figure 23

Nodosaria lepidula Schwager, 1866, Novara-Exped. Geol. Theil., vol. 2, p. 210, pl. 5, figs. 27–28; Pliocene.—Galloway and Morey, 1929, Bull. Am. Paleontology, vol. 15, no. 55, p. 17, pl. 2, fig. 2; Eocene, Ecuador.—Galloway and Morey, 1931, Jour. Paleontology, vol. 5, p. 337, pl. 38, fig. 1, Upper Cretaceous, Mexico.

Ellipsonodosaria sp. Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 70, pl. 12, figs. 1, 2; Midway group, Paleocene, Alabama.

Test elongate, tapering, straight; chambers globular, smooth except that for lower margin is angular, fimbriate; diameter, 0.078–0.17 mm.; length, 5 chambers, 0.55 mm.

E. lepidula is distinguished by the globular, almost spherical chambers, which are connected by short "necks," and which are smooth except for a very narrow fimbriate margin on the lower edge. Rare in the late Cretaceous of Mexico and the lower Midway of Alabama.

ELLIPSONODOSARIA PLUMMERAE Cushman
Plate 54, figures 18, 19

Ellipsonodosaria plummerae Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 69, pl. 12, figs. 4, 5; Midway group, Pliocene, Texas.

Test elongate, somewhat tapering, straight; chambers pyriform, distinct, increasing in size and becoming more pyriform upward, very spinose, especially at ridge near base of chamber; aperture terminal, rounded, phialine; diameter, 0.078–0.13 mm., length, 5 chambers, 0.61 mm.

This species seems very close to *E. pseudoscripta* Cushman from the Upper Cretaceous and to *E. sagrinensis* (Bagg) from the Midway. It differs from the latter, however, in its more elongate chambers and from the former by the more abrupt margins on the lower edges of the chambers.

ELLIPSONODOSARIA SAGRINENSIS (Bagg)
Plate 54, figure 22

Nodosaria sagrinensis Bagg, 1912, U. S. Geol. Survey Bull. 513, p. 58, pl. 16, fig. 4; Pliocene, California.—Plummer, 1927, Texas Univ. Bull. 2644, p. 85, pl. 4, fig. 16; Midway group, Paleocene, Texas.

Nodogenerina sagrinensis Jennings, 1936, Bull. Am. Paleontology, vol. 23, p. 187, pl. 3, fig. 17; Hornerstown, Eocene, New Jersey.

Test straight, tapered; chambers short to globular in early stages, becoming more elongate later, lower edge fimbriate, upper part narrowing toward sutures, wall thickly spinose; spines short above, longer below, overhanging lower edge; sutures deep, broad; average diameter, 0.10 mm.; length, 5 chambers, 0.50 mm.

This species was placed in synonymy with *E. plummerae* by Cushman (1940, p. 69) but its chambers do not seem to be sufficiently elongate to warrant its reference to that species. It is abundant in the upper, but rare to common in the lower Midway of Texas, and has also been reported from the Navarro.

ELLIPSONODOSARIA SPINULOSA (Plummer)
Plate 54, figure 20

Nodosaria spinulosa (part) Plummer, 1927, Texas Univ. Bull. 2644, p. 85, pl. 4, fig. 19a, b only; Midway, Paleocene, Texas.

Test elongate, tapering, straight to slightly arcuate; chambers somewhat elongate, covered with spine-terminated ribs; sutures depressed; average diameter, 0.10 mm.; height, 7 chambers, 0.50 mm.

This form differs from *Nodosaria spinocostata* n. sp. and from *N. spinulosa* Plummer (1927, pl. 4, fig. 19c), in that its ribs may terminate in spines over the entire chamber wall while in *N. spinocostata* the ribs occupy the entire length of the chamber wall and terminate in a spine overhanging the sutural depression.

Family ROTALIIDAE Reuss
Genus EPONIDES Montfort
EPONIDES EXIGUA LIMBATA (Plummer)
Plate 55, figures 11–13

Pulvinulina exigua limbata Plummer, 1927, Texas Univ. Bull. 2644, p. 152, pl. 11, figs. 4a–c; Midway group, Paleocene, Texas.
?Eponides sp. Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 71, pl. 12, figs. 8a, b; Midway group, Paleocene, Alabama.

Test small, biconvex, peripheral margin sharp or acute, indistinctly lobed, chambers 5 in final whorl, smooth; sutures very indistinct, on dorsal side oblique, straight, narrow; ventral sutures flush, almost straight but slightly curved from umbilicus; diameter, 0.30 mm.; thickness, 0.20 mm.

This species and its two varieties are common in the Midway of Texas. The variety *limbata* is common in the basal strata and var. *exigua* forms a good marker for the lower beds. The Alabama form is limited to the upper Midway.

Genus SIPHONIA Reuss
SIPHONIA PRIMA Plummer
Plate 55, figures 7–9

Siphonia prima Plummer, 1927, Texas Univ. Bull. 2644, p. 148, pl. 12, figs. 4a–c; Midway group, Paleocene, Texas.—Cushman, 1927, U. S. Nat. Mus. Proc., vol. 72, art. 20, p. 2, pl. 2, figs. 4a–c.—Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 71, pl. 12, fig. 10; Midway group, Paleocene, Alabama; Navarro, Cretaceous, Gulf Coast Embayment.

Test circular, biconvex; peripheral angle acute; margin lobate, chambers 5 in last whorl; dorsal sutures curved, broad; ventral sutures straight, narrow, excavated, radiate from shallow central depressed area; diameter, 0.35 mm.; thickness, 0.20 mm.

It is common in the upper Midway of Texas, Alabama, Arkansas, Mississippi, and Tennessee, but is also present in the Upper Cretaceous (Navarro) in these states.

Family GLOBIGERINIDAE Carpenter
Genus GLOBIGERINA d'Orbigny
GLOBIGERINA COMPRESSA Plummer
Plate 54, figures 8, 9

Globigerina compressa Plummer, 1927, Texas Univ. Bull. 2644, p. 135, pl. 8, figs. 11a–c; Midway group, Paleocene, Texas.—Jennings, 1936, Bull. Am. Paleontology, vol. 23, p. 193, pl. 31, fig. 8; Hornerstown formation, Eocene, New Jersey.—Toulmin, 1941, Jour. Paleontology, vol. 15, p. 607, pl. 82, figs. 1, 2; Salt Mountain limestone, Eocene, Alabama.

Test small, quadrate, closely coiled, compressed, margin lobate; chambers increasing regularly, inflated, overlapping dorsally; sutures strongly depressed; wall thin, smooth, finely punctate; single aperature arched; diameter, 0.30 to 0.40 mm.

It is common in the upper Midway of Texas.

GLOBIGERINA TRILOCULINOIDES Plummer
Plate 54, figures 12, 13

Globigerina triloculinoides Plummer, 1927, Texas Univ. Bull. 2644, p. 134, pl. 8, figs. 10a–c; Midway group, Paleocene, Texas.—Jennings, 1936, Bull. Am. Paleontology, vol. 23, p. 193, pl. 31, fig. 10; Hornerstown formation, Eocene, New Jersey.—Glaessner, 1937, Moscow Univ. Publ. Lab. Paleontology, vols. 2–3, p. 382, pl. 4, figs. 33a, b; Lower Tertiary, Caucasus.—Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 72, pl. 12, fig. 15; Midway group, Paleocene, Alabama.—Toulmin, 1941, Jour. Paleontology, vol. 15, p. 607, pl. 82, fig. 3; Salt Mountain limestone, Eocene, Alabama.

Test very small, trochoid, periphery distinctly lobate; last volution formed by 3 large globular chambers which increase rapidly in size; surface finely punctate; diameter, 0.25 to 0.30 mm.

It is common in the upper Midway of Texas and Alabama and the Salt Mountain limestone of the Alabama Wilcox.

Family ANOMALINIDAE Cushman
Genus ANOMALINA Bermúdez
ANOMALINA ACUTA Plummer
Plate 54, figures 3–5

Anomalina ammonoides acuta Plummer, 1927, Texas Univ. Bull. 2644, p. 149, pl. 10, figs. 2a–c; Midway group, Paleocene, Texas.
Anomalina acuta, Glaessner, 1937, Moscow Publ. Lab. Paleontology, vols. 2–3, p. 386, pl. 5, figs. 39a–c. Lower Tertiary, Caucasus.—Toulmin, 1941, Jour. Paleontology, vol. 15, p. 608, pl. 82, figs. 9, 10; Salt Mountain limestone (lower Wilcox).

Test compressed, involute, about equally biconvex, periphery acute; chambers narrow, numerous, 13 in last whorl; dorsal sutures distinct, limbate to slightly depressed; ventral sutures thickened around umbilical area, merging into prominently developed

or elevated central boss; shell perforate; diameter, 0.31 mm.; thickness, 0.12 mm.

This species is common in the two faunal zones of the Midway of Texas and serves to distinguish these horizons from the underlying Cretaceous formations. It also occurs in the lower Wilcox of Alabama.

ANOMALINA MIDWAYENSIS (Plummer)
Plate 54, figures 15–17

Truncatulina midwayensis Plummer, 1927, Texas Univ. Bull. 2644, p. 141, pl. 9, figs. 7a–c, pl. 15, figs. 3a–b; Midway group, Paleocene, Texas.
Anomalina midwayensis, Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 73, pl. 12, fig. 18; Midway group, Paleocene, Texas.

Test biconvex, little compressed; chambers 9 to 10 in last whorl, punctate; sutures strongly elevated, broad near umbilicus but separated from it, tapering toward margin, curved; slit-like aperature at base of septal face; diameter, 0.41 mm., thickness, 0.22 mm.

This form is identical with the Texas Midway form in all respects except that it is somewhat thicker and the sutures a little wider, especially near the umbilicus. The species is found throughout the Midway of Texas and in the upper Midway of Alabama.

Genus CIBICIDES Montfort

CIBICIDES ALLENI (Plummer)
Plate 54, figures 24, 25

Truncatulina alleni Plummer, 1927, Texas Univ. Bull. 2644, p. 144, pl. 10, figs. 4a–c; Midway group, Paleocene, Texas.—Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 73, pl. 12, fig. 19; Midway group, Paleocene, Alabama.

Test unequally biconvex, more rounded on ventral side; peripheral margin slightly acute, somewhat lobate; chambers, 9? in last whorl, coarsely punctate; sutures and periphery conspicuously marked by shell material; sutures curved, gently tapering from large, smooth umbilicus; aperature large, arched, extending far down on ventral side; diameter, 0.60 to 0.80 mm.

It is common in the middle and upper Midway of Texas and Alabama but is rare in the Navarro.

CIBICIDES VULGARIS (Plummer)
Plate 54, figures 28, 29

Truncatulina vulgaris Plummer, 1927, Texas Univ. Bull. 2644, p. 145, pl. 10, figs. 3a–c; Midway group, Paleocene, Texas.—Cushman, 1940, Cushman Lab. Foram. Research Contr., vol. 16, p. 73, pl. 12, fig. 21; Midway group, Paleocene, Alabama.

Test unequally biconvex; periphery broadly rounded, lobate; chambers 8 in last whorl, later ones turgid; sutures curved, tapering, elevated by shell material, walls coarsely punctate; slit-like aperature extending from periphery to umbilicus; diameter, 0.60 to 0.85 mm.

It is abundant in the upper and rare in the lower Midway of Alabama and Texas.

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JOURNAL OF PALEONTOLOGY, VOL. 18, NO. 4, PP. 355–362, PLS. 56, 57, 1 TEXT FIG., JULY 1944

LOWER CARBONIFEROUS CORALS OF THE GENERA ROTIPHYLLUM AND PERMIA

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Morton Banks, Keighley, England

ABSTRACT—An abundant fauna of zaphrentoid corals has recently been collected from the *Rylstonia* shale of Middle Viséan age at Clints rock quarry, Rylstone, Yorkshire, England. Twenty-two of the specimens are forms with a hollow axial structure known as a stereotheca. In some specimens the stereotheca is an ephebic growth-stage modification of a stereocolumn. This form is a variety of another member of the fauna, *Rotiphyllum rushianum* (Vaughan), which, since it is the type of the genus, is redescribed in more detail than previously and is considered to be closely related to *Fasciculophyllum densum* (Carruthers). Two other closely related forms, belonging to the genus *Permia* Stuckenburg, are described as new species: this genus is considered to be an homeomorph of the Silurian genus *Syringaxon* Lindström, which is also characterized by a stereotheca. The general trend of structural development in these corals is briefly discussed.

CLINTS rock quarry, near Rylstone, Yorkshire, England, is well known because of the occurrence there of a thin shale containing an abundant zaphrentoid coral fauna (Wilmore, 1910; Booker and Hudson, 1926). The fauna is Middle Viséan in age, that is, it belongs to the S_2D_1 zone in the coral-brachiopod succession of Vaughan. It is unique among the described coral faunas of that age because it is the only one of zaphrentoid phase; all others are of standard phase, with *Clisiophyllum*, *Lithostrotion*, *Palaeosmilia*, and their allies. The only other described fauna of zaphrentoid phase which is possibly of the same age is that described by Vaughan (1906, 1908) from the lower *Cyathaxonia* beds (R21) of Rush, Eire.

The three species *Rylstonia benecompacta* Hudson and Platt, *Rhopalolasma bradbournensis* (Wilmore), and *Caninia amplexoides* (Wilmore), and their related forms make up the greater part of the Rylstone fauna. There are, however, certain other forms some of which were listed as *Zaphrentis costata* (McCoy) by Wilmore (1910) and by Booker and Hudson (1926). Examination of the lectotype of *Z. costata* McCoy and of

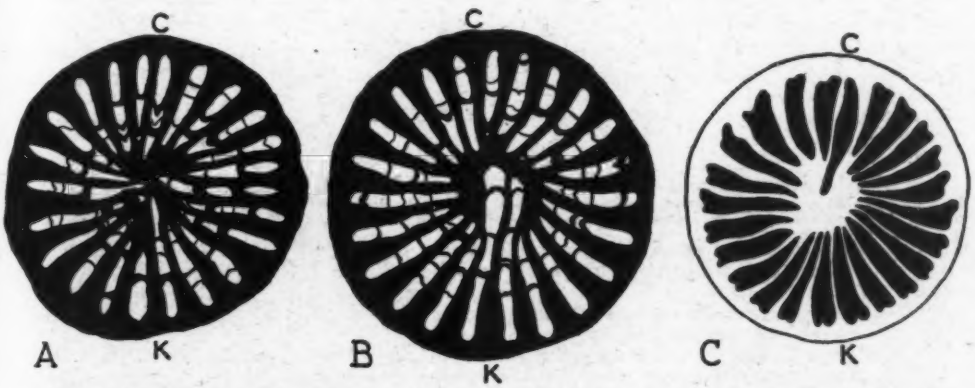


FIG. 1—Diagrammatic representations of transverse sections of (A and B) *Rotiphyllum costatum* (McCoy) and (*C*) *Rotiphyllum rushianum* (Vaughan). *A* and *B*, transverse sections, ×4.7, (*A*, 8.0 mm. diam., early ephebic growth-stage; *B*. 8.5 mm. diam., late ephebic growth-stage) of B.M. R34610, from *R. costatum* beds, Cawdor Quarry, Matlock, Derbyshire. *C*, transverse section, ×4.2 (8.5 mm. diam., late ephebic growth-stage), from base of calyx of holotype, T.C.D., T10/1009, from *Cyathaxonia* beds, Rush, Eire.

several sectioned topotypes (text figs. 1a, b) shows that although the Rylstone forms are probably members of the same species-plexus as *Z. costata* they can not be referred to that species. In 1908 Vaughan founded *Densiphyllum rushianum* on a specimen from the R21d level in the *Cyathaxonia* beds of Rush. Although only the figured calicular transverse section of the holotype (Vaughan, 1906, pl. 29, fig. 6) is available for comparison, there is no doubt that the specimens from Rylstone previously referred to as *Z. costata* McCoy are *D. rushianum* Vaughan, because transverse sections almost identical with that of the holotype of that species can be made from specimens from Rylstone. Vaughan considered his species to belong to the genus *Densiphyllum* Dybowski, whose genotype is *D. thomsoni* Dybowski, from the Silurian of Esthonia. The description and figures of this species show that it is unlikely to be congeneric with *D. rushianum* Vaughan and a new genus *Rotiphyllum* was therefore founded by the author (Hudson, 1942b), with Vaughan's species as genotype. *Z. costata* McCoy is also referred to this genus. *Rotiphyllum rushianum* (Vaughan) is redescribed in more detail than previously.

All specimens, other than the holotype of *Rotiphyllum rushianum*, described in this paper are in the collection of the Department of Geology, British Museum of Natural History and are catalogued under the numbers R34635-41 and R34653-56; these numbers are preceded in this paper by the letters B.M. All the specimens are from the *Rylstonia* shale, Clints rock quarry, Rylstone, near Skipton, Yorkshire, zone S_2D_1 Middle Viséan, Lower Carboniferous.

Genus ROTIPHYLLUM Hudson, 1942.

Genoholotype—Densiphyllum rushianum Vaughan, 1908.

Diagnosis—Zaphrentoid corals of the *Fasciculophyllum omaliusi* gens with evenly-spaced, radial major septa, which meet axially and form a stereocolumn. Cardinal fossulae on convex side of corallum, usually extend to the septal axis; alar fossulae indistinguishable from other loculi. Septal plan in early growth-stages similar to that in other species of the *F. omaliusi* gens.

ROTIPHYLLUM RUSHIANUM (Vaughan)

Plate 56, figures 1a–c, 2; text figure 1c

Densiphyllum (zaphrentoid subdivision). Vaughan, 1906, p. 318, pl. 29, fig. 6.
Densiphyllum rushianum Vaughan, 1908, p. 459; 1915, p. 35.
Zaphrentis costata (McCoy), Wilmore, 1910, p. 551; Booker and Hudson, 1926, p. 424.
Zaphrentis sp. aff. *Z. nodosa* (Smyth), Garwood and Goodyear, 1924, pl. 18, fig. 5

Holotype—Transverse section T10, 1009 (Department of Geology, Trinity College, Dublin) from level R21d, *Cyathaxonia* beds, coast section, Rush, Eire. *Dibunophyllum* zone, Viséan. Figured by Vaughan (1906, pl. 29, fig. 6) and in this paper (text-fig. 1c).

Plesiotypes—B.M. R34639a, and trs. sects. R34639b–e; B.M. R34638a, d, e, and trs. sects. R34638b–c (*R. rushianum* towards var. *cavum*); B.M. R34654. R34639b, d, e and R34638a and e are illustrated as figs. 1a–c, 2, pl. 56 and fig. 5, pl. 57 this paper.

EXPLANATION OF PLATE 56

All figures on plates 56 and 57 are of specimens and transverse sections of specimens from the *Rylstonia* shale, Clints Rock Quarry, Rylstone, near Skipton, Yorkshire, England, zone S_2D_1, Middle Viséan, Lower Carboniferous. *K*, counter septum; *KLI*, first counter lateral septum; *CLI*, first cardinal lateral septum; *C*, cardinal septum; *km*, counter minor septum.

FIGS. *1—Rotiphyllum rushianum* (Vaughan), plesiotype, B.M. R34639. *a*, R34639b, neanic growth-stage, ×6; *b*, R34639d, early ephebic growth-stage, ×6; *c*, R34639e, ephebic growth-stage, ×6. (p. 356)

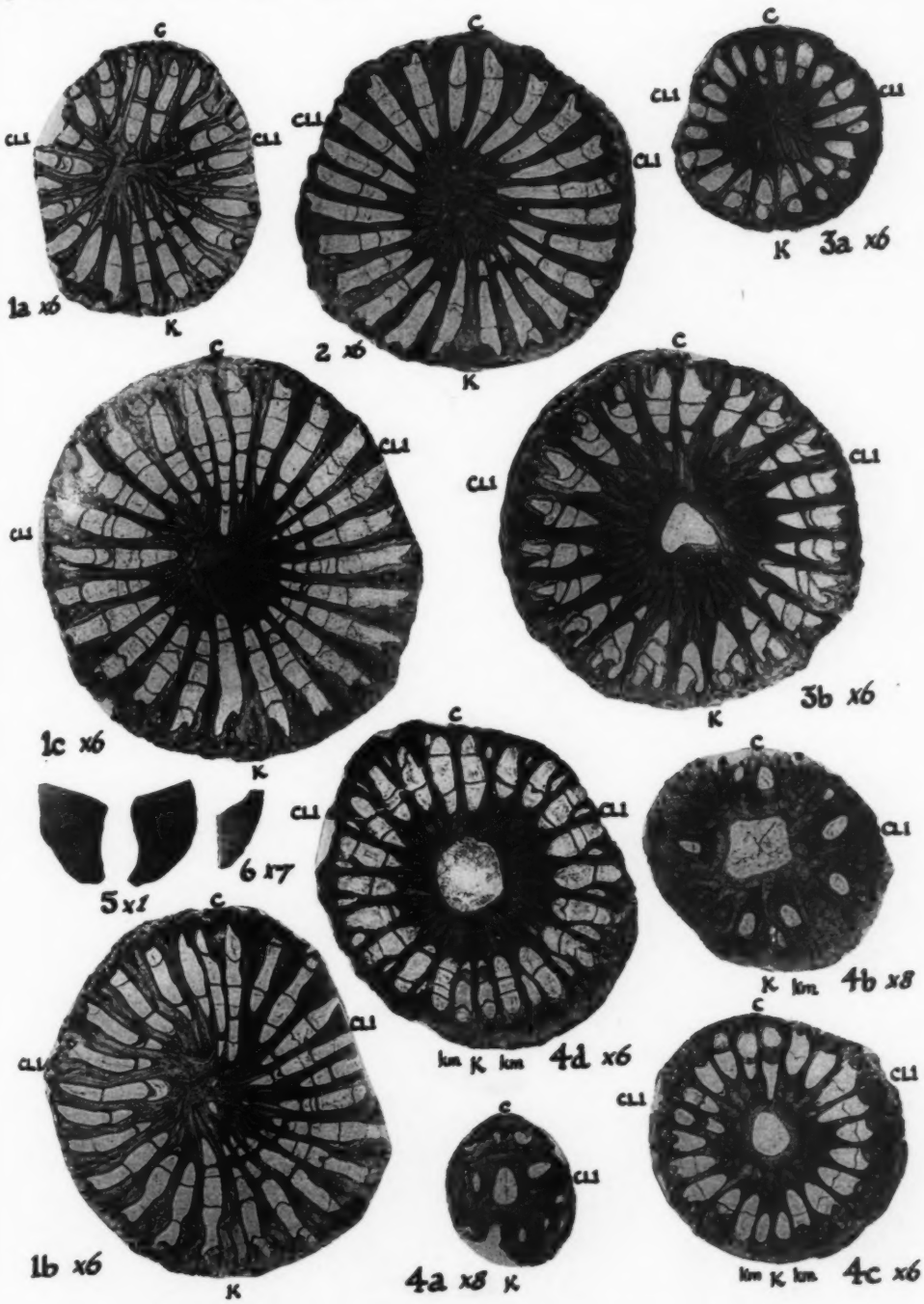
2—Rotiphyllum rushianum cavum, Late neanic growth-stage, B.M. R34638a, ×6. Note stereome in center of stereocolumn.

3—Permia caverna n. sp., Holotype B.M. R34641. *a*, R34641a, neanic growth-stage showing compact stereocolumn, ×6; *b*, 34641c, ephebic growth-stage showing stereotheca and contratingent minor septa, ×6. (p. 360)

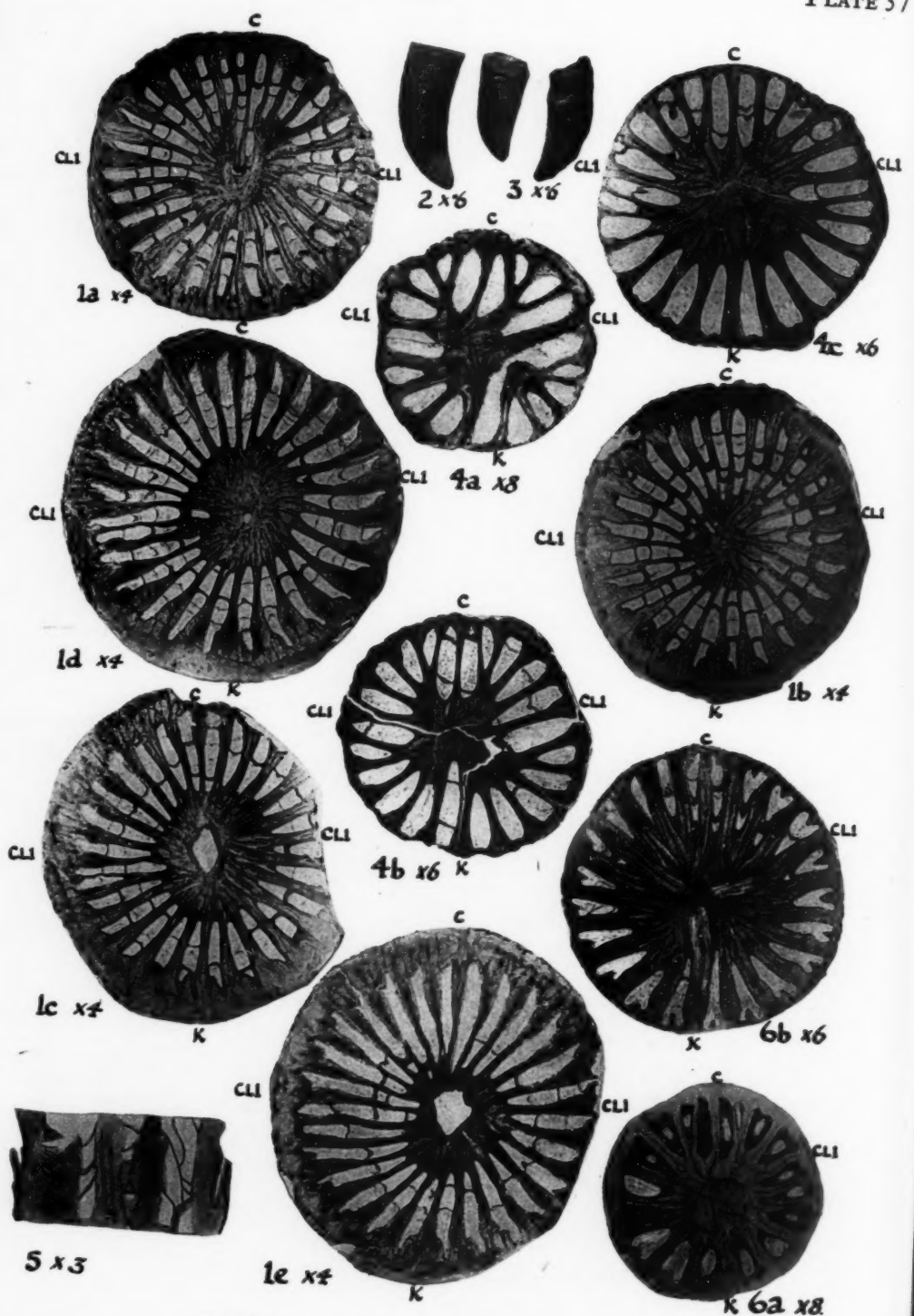
4—Permia carbonaria n. sp. Holotype, B.M. R34640. *a*, R34640a, transitional growth-stage, ×8; *b*, R34640b, early neanic growth-stage showing possible counter minor septum, ×8; *c*, R34640c, neanic growth-stage showing long counter minors and short counter, ×6; *d*, R34640d, ephebic growth-stage, ×6. (p. 361)

5—Permia caverna, n. sp. Two specimens. ×1. (p. 360)

6—Permia carbonaria n. sp. ×0.7. (p. 361)



Hudson—Lower Carboniferous corals



Hudson—Lower Carboniferous corals

Description[1]—*Rotiphyllum* with slightly curved corallum, mainly ceratoid but occasionally cylindrical at distal end; usually about 25 mm. long and 10 mm. calicular diameter. Epitheca smooth or with fine growth annulations. About 24 to 28 major septa, usually 6 KL, 6 CL or 7 KL, 6 CL, occasionally 7 KL, 5 CL or 6 KL, 7 CL, slightly concave to cardinal or straight, peripherally dilated and slightly nodose, axially slightly rhopaloid and joined by axial stereome forming stereocolumn, which tends to be oval and is about one-third the diameter of corallum. Counter septum long and rhopaloid; cardinal long, slightly thinner and leans on an adjacent cardinal lateral. Cardinal fossulae, on convex side of corallum, narrow to stereocolumn and then parallel-sided within stereocolumn. Counter pseudofossulae slightly longer than other loculi. Minor septa stumpy and nearer to the major septum on counter side. Counter minors slightly stronger. Tabulae incomplete and conical.

The only type specimen available is the transverse section of the holotype, figured by Vaughan (1906, pl. 21, fig. 6, and in this paper, text fig. 1c), from the base of the calyx; it has not been possible to obtain topotypes. The epitheca is 1 mm. thick, an abnormal and not a diagnostic feature: such thickening is seen in other specimens just previous to dedifferentiation. Vaughan's statement (1908, p. 460) that "the fossula apparently lies in all cases on the concave side" is later (Vaughan, 1915, p. 35) corrected.

[1] The septal formulae and terminology used in these descriptions are these defined by the author in a previous paper (Hudson, 1936).

Ontogeny.[2]—The earliest transverse section obtained (4 mm. diam.) is at the early neanic growth-stage. It has 18 palmately-grouped septa (4 KL, 4 CL) meeting at the septal axis. The swollen cardinal fossulae are divided by a long cardinal septum and there are prominent alar fossulae. The section is very similar to that figured on plate 57, figure 4a. Subsequent neanic sections (pl. 56, fig. 1a and sections similar to those figured on plate 57, figs. 4b, c show septa almost radial, a long and slightly rhopaloid counter septum, a wide and parallel-sided cardinal fossular area and a stereocolumn. In the late neanic growth-stage (pl. 56, fig. 2) the septal plan is almost radial, the cardinal fossulae being inconspicuous and narrowing inwards as do the other loculi.

Phylogeny—The general structure places the species in the *Fasciculophyllum omaliusi* group and the ontogeny suggests a derivation from *Rotiphyllum densum* (Carruthers). The general septal plan of the early neanic stage is that of *F. omaliusi* (Edwards and Haime), a characteristic feature being the swollen cardinal fossulae bisected by the cardinal septum; the middle neanic stage with the parallel-sided cardinal fossular area is similar to that of the late neanic *R. densum* (compare pl. 56, fig. 1a, pl. 57, figs. 4b, c

[2] The growth of the individual is divided into the following stages:

Brephic growth-stage—development of protosepta (cardinal and counter septa).

Transitional growth-stage—Development of structures approaching those characteristic of the genus.

Neanic growth-stage—Structure attains that of genus and proceeds towards that of the species.

Ephebic growth-stage—Structure characteristic of the species.

EXPLANATION OF PLATE 57

(See explanation of Plate 56 for horizon and locality of figured specimens and explanation of septal notation.)

FIGS. *1*—*Rotiphyllum rushianum cavum* n. var. Holotype B.M. R34635. *a*, R34635a, late neanic growth-stage, ×4; *b*, R34635b, early ephebic growth-stage, ×4; *c–e*, R34635c–e, ephebic growth-stage, ×4. (p. 358)

2—*Rotiphyllum rushianum cavum*, n. var., ×0.6. (p. 358)

3—*Rotiphyllum rushianum* (Vaughan), two specimens. ×0.6. (p. 358)

4—*Rotiphyllum* aff. *R. rushianum cavum*, n. var. B.M. R34636. *a*, R34636a, early neanic growth-stage, ×8; *b–c*, R34636b–c, neanic growth-stage, ×6. (p. 358)

5—*Rotiphyllum rushianum cavum*, drawing of longitudinal section through ephebic corallum. B.M. R34638e, ×3. (p. 358)

6—*Rotiphyllum* sp. cf. *R. densum* (Carruthers), B.M. R34637. *a*, R34637a, early neanic growth-stage (compare fig. *4a*), ×8; *b*, R34637c, late neanic growth-stage, ×6. (p. 358)

with Carruthers, 1908, pl. 4, fig. 7a), while the late neanic stage with its radial septa and inconspicuous cardinal fossulae has a similar septal plan to *R. densum* (compare pl. 56, fig. 2 with Carruthers, 108, pl. 4, fig. 7). The only significant difference between the structures of the neanic stages of *R. rushianum* and those of the various stages of *R. densum* is that in the former the septa are more radial than in the latter where the concave curvature to the cardinal is persistent.

Lateral variation—Material is not sufficient to gauge the extent of the lateral variation. Occasional specimens of *R. densum* occur (B.M. R34653a–c). A few specimens do not advance beyond the late neanic septal plan of *R. rushianum;* they may be immature individuals of that species or they may belong to a morphologically earlier form in the species-plexus, such as *R. densum.* There is more variation in the structure of the stereocolumn: in some forms, such as B.M. R34638, the septa end short of the septal axis leaving a distinct axial area penetrated only by the counter septum and filled with stereome (pl. 56, fig. 2). Occasionally, as in B.M. R34638D, the axial infilling is absent and the stereocolumn temporarily becomes a hollow axial structure or stereotheca. In other forms this stereotheca is a persistent structure in the ephebic corallum and these forms are described below as a variety of *R. rushianum.*

ROTIPHYLLUM RUSHIANUM CAVUM Hudson, var. nov.
Plate 57, figures 1a–5

Holotype—Transverse sections B.M. R34635a–e, figured pl. 57, figs. 1a–e.

Paratype—B.M. R34636f and trs. sects. R34636a–e (*R.* aff. *rushianum* var. *cavum*). R34636a–c (pl. 57, figs. 4a–c).

Description—Youthful corallum ceratoid, later cylindrical and slightly oval in transverse section; about 30 mm. long and, distally, 12 or 13 mm. wide. Septal plan radial. About 28 major septa, usually 7 KL, 6 CL, straight or only slightly concave to cardinal, and slightly rhopaloid. Cardinal and counter septa as other major septa except that cardinal is very slightly thinner. Major septa do not extend to axis: axial ends joined by stereome to form an oval, tubular stereocolumn, or stereotheca, about 4 mm. external and 1 to 1.5 mm. internal diameter (pl. 57, figs. 1c, e). Occasionally the axial tube is filled with stereome thus forming a compact stereocolumn (pl. 57, fig. 1d). There are no cardinal or other fossulae though occasionally in sections just below the calyx the axial area is continuous with one of the cardinal fossulae. Other features as in *Rotiphyllum rushianum.*

Ontogeny—The ontogeny of the variety up to the late neanic stage is that of the main species except that the septa throughout are straighter. At the late neanic stage (pl. 57, fig. 1a) there is a long cardinal septum and narrow cardinal fossulae; the septal plan at this stage is thus that of the ephebic *R. rushianum.*

Variation—The variety differs from the main species by the tubular stereocolumn, by the absence of cardinal fossulae and by a larger counter septum. In some forms, such as B.M. R34636, these features are not well developed and the structure is between *R. rushianum* and its variety: in most of these forms the septa have usually withdrawn from the septal axis but the axial tube is completely filled by stereome.

ROTIPHYLLUM cf. R. DENSUM (Carruthers)
Plate 57, figures 6a–b

Typical specimen—B.M. R34637d and transverse sections B.M. R34637a–c. R34637a and c are figured as plate 57, figs. 6a–b, this paper.

Description—Only one specimen of this form has been sectioned. Its difference from *R. rushianum* is evident when sections of similar diameter are compared, such as plate 57, figure 6a with figure 4d, and figure 6b with figure 4c. The general feature of the septal plan is the emphasis on the structures characteristic of *R. densum* resulting in stout septa, a wide stereocolumn, thick tabulae, and long counter and second cardinal lateral septa. Minor septa are short, the counter minors being slightly longer. All fossulae are absent and the septa are straighter than in *R. densum.*

In the early neanic growth-stage (pl. 57, fig. 6a) there are 18 septa (4 KL, 4 CL) at 4 mm. corallum diameter. The stereocolumn is about half this diameter, the septa

straight and the cardinal fossulae parallel-sided. In the middle neanic growth-stage (B.M. R34637) there are 22 nodose septa (5 KL, 5 CL) at 5 mm. diameter. K is long, the cardinal fossulae are parallel-sided, and the stereocolumn is about two-thirds of the corallum diameter. There is considerable deposition of stereome on the sides of the septa. In the late neanic stage (pl. 57, fig. 6b) there are 22 septa at 7 mm. diameter. The stereocolumn is slightly more than one-half the corallum diameter. K and CL2 are long. The minor septa are stumpy. In the ephebic stage there are 26 slightly nodose septa (6 KL, 6 CL) at 8 mm. diameter and the stereocolumn has a diameter less than half that of the corallum.

The form belongs to the *F. omaliusi* gens and shows links with *R. densum*. The tendency towards a tachylasmoid septal plan[3] with K and CL2 dominant suggests that the form may be part of the same species-plexus as the specimens previously figured by the author as *Phryganophyllum* sp.

GENERAL TREND OF STRUCTURAL CHANGE

The change in the internal structure of the coralla in the *F. omaliusi-R. rushianum* group may be briefly summed up as follows.

(a) A change in septa plan resulting from a change in the grouping of the septa from tetrameral and palmate to radial, with the consequent formation of straight septa and a stereocolumn and alterations in the outline of the fossulae.

(b) An increase in the number of tabulae and a decrease in septal length with the consequent formation of a stereotheca.

In general, the changes in septal plan preceded those in septal length, though there is a variable amount of overlap. The former were mainly effected in the sequence *F. omaliusi* to *R. rushianum*, the latter in the sequence *R. rushianum* to *R. rushianum* var. *cavum* and a succeeding species not as yet named or described. The changes are paralleled in those occurring in the species-plexus *Zaphrentites delanouei* to *Z. brevisepta* (Hudson, 1941).

The author considers that these changes are the expression of the mechanical adjustment of the structure of the organism to changes in its position and rate of growth: both can be correlated with the change in the shape of the corallum from curved trochoid to almost straight ceratoid-cylindrical and were probably conditioned by it.

[3] A tachylasmoid septal plan is one in which there is marked differentiation in size of the major septa. The genera *Claviphyllum* Hudson, *Cryptophyllum* Carruthers, *Phryganophyllum* de Kon., *Plereophyllum* Hinde, *Rhopalolasma* Hudson, *Tachylasma* Grabau have such a septal plan though the prominent septa are not necessarily KL1 and CL1 as in *Tachylasma*. There are in British Carboniferous corals two main tachylasmoid septal plans: one is that of *Rhopalolasma* in which the important longer septa are KL1 and CL1 (*Cryptophyllum* probably belongs to this group); the other that of *Claviphyllum* in which the important longer septa are K and CL2 (*Phryganophyllum* probably belongs to this group).

Genus PERMIA Stuckenberg, 1895

Permia Stuckenberg, 1895, p. 26, 186.
Crassiphyllum Grove, 1935, p. 368.
Genotype.—*P. iwanowi* Stuckenberg, 1895, p. 27 and 187, pl. 3, figs. 6a–g. From Lower Carboniferous, Western slopes of Urals.

PERMIA IWANOWI Stuckenberg

Holotype—Specimen figured Stuckenberg, 1895, pl. 3, figs. 6a–b.

Paratypes—Specimens figured Stuckenberg, 1895, pl. 3, figs. 6c–d, 6e, 6f–g.

Translation of original description—Simple corals with curved, conical coralla, approximately circular in cross section. Corallum length up to 20 mm., corallum diameter 15 mm. In the centre of the calyx, which is 8 mm. deep, there is a thick hollow tubular columella [stereotheca] not quite 2 mm. in diameter with a wall thickness which does not exceed 1 mm. The small tube-shaped pillar, which has a finely ribbed outer surface, extends from the bottom of the corallum to 3 mm. above the floor of the calyx. A retarded cardinal septum occurs in a medial fossula on the convex side of the corallum. The 38 stout major septa reach the small boss not far from the base of the calyx: higher in the calyx, a circular free space [calicular pit] occurs between the septa and the columella. The 39 smallish minor septa alternate with the major but can be seen only at the margin of the calyx rim. The above figures are from a specimen 20 mm. long by 15 mm. diameter. In another specimen, 12 mm. diameter,

the total number of septa was not 78 but 66. The epitheca shows weakly marked septal grooves and annulations.

Details from plate 3, figures 6a–g—The dimensions and number of septa given by Stuckenberg do not agree with those of his figures on plate 3. Figures 6a, b, presumably his type specimen, of 15 mm. diameter, has 31 major septa (15 left laterals and 14 right laterals, presumably 7 KL, 7 CL). The counter minors appear to be slightly longer than the other minors. The stereotheca is larger than stated by Stuckenberg, being 3.5 mm. external diameter and 2 mm. internal. A cross section of about 6 mm. diameter has 20 major septa (fig. 6f). There are no dissepiments.

Remarks—No species other than the genotype have been allocated to the genus *Permia* and, as far as the author knows, no specimens of that species have been recorded other than those used by Stuckenberg in his original description.

The genus *Crassiphyllum* was founded by Grove (1935) with genotype *Zaphrentis declinis* Miller from the Keokuk group, Mississippian, of Indiana, U.S.A. The genotype is a small, slightly curved, ceratoid to cylindrical coral. It has an axial tube, continuous from the tip of the corallum, which is called a phyllotheca by Grove but which is the same as a stereotheca as interpreted in this paper. There are slight cardinal fossulae on the convex side of the corallum. At 10 mm. corallum diameter there are 24 thick, radial, major septa and no minor septa (it is possible that the thickened bases of the major septa seen in Grove's figures (1935, pl. 12, p. 377) may be due to incipient minor septa). There are no tabulae. Grove also records a few marginal dissepiments which are usually confined to the earlier growth stages of the corallum. These structures are shown in a section (2.5 mm. diameter and with 17 septa) figured by Grove (1935, pl. 12, fig. 16) and may be similar to the dissepiment-like plates occurring in *Permia carbonaria* (pl. 56, fig. 4c.) The structure of *Z. declinis* Miller is such, therefore, that it can be included in the genus *Permia* Stuckenberg, 1895, of which therefore *Crassiphyllum* Grove, 1935, is considered to be a synonym.

The genus *Neozaphrentis* Grove, 1935, was founded on the genotype *Zaphrentis tenella* Miller. This species, according to Grove (1935, p. 361), has radial septa and a stereotheca in the neanic growth-stage. Later, however, the septa are axially free and pinnate about the cardinal fossulae. In spite of the similarity of its earlier structure, the genus *Neozaphrentis* has probably no relation to the genus *Permia*.

The Tournaisian *Laccophyllum cyathaxoniaeforme* Gorsky (1932) and *L. turbinatum* Gorsky (1932) should, in spite of their axial tabulae, be included in the genus *Permia*, as should the Viséan *Barrandeophyllum choniukounense* Grabau (1928) and possibly the other species allocated by Grabau to that genus. The specimens described by the author (Hudson, 1942a) from the basal Viséan (lower C_2) of Yorkshire under the names "*Zaphrentis*" *A* cf. *Syringaxon* and '*Zaphrentis*' *B* are similar in structure to *Permia*. *Zaphrentis postuma* Smith (1931, p. 4, figs. 1–4, 9) is a species in which, in the ephebic stage, "the axial edges of the septa join to form a ring round the axis or are free." This species belongs to the *Zaphrentites delanouei* gens and is therefore an illustration of the development of the stereotheca in a lineage other than those of *Permia* or *Rotiphyllum*.

The Silurian genus *Syringaxon* Lindström (Butler, 1935) (synonyms, *Laccophyllum* Simpson, *Alleynia* Pocta) has an almost identical structure with *Permia*, the chief difference being that in the former the development of the minor septa is in part serial while in the latter it is cyclic. Though little is known of the immediate relations of *Syringaxon*, it is probable that *Permia* and *Syringaxon* are homeomorphs, since the stereotheca, the diagnostic structure, is a modification of the stereocolumn and occurs towards the end of several lineages of small conical corals. It is also probable that the Carboniferous genus *Permia* is a composite one.

PERMIA CAVERNA Hudson, n. sp.
Plate 56, figures 3a–b, 5

Holotype—Transverse sections B.M. R34641a–c; a and c figured pl. 56, figs. 3a, b.

Paratype—B.M. R34655.

Description—Curved trochoid corallum about 15 mm. wide and 20 mm. long; epitheca with fine growth annulations. Major

septa 22 to 24, straight, rhopaloid, joined axially to form a stereotheca; counter septum slightly shorter, cardinal septum thinner than others. In section below calyx floor of 14 mm. diameter and with 23 septa, the stereotheca is 2.5 mm. internal and 7 mm. external diameter; in section figured as pl. 56, figure 3b, at 8.5 mm. diameter and with 22 septa (6 KL, 4 CL) the stereotheca is 1.3 mm. internal and 4 mm. external diameter. The minor septa stumpy and either buried in a slight peripheral stereozone or free and, in transverse section, looped to the major septum on the cardinal side by a tabular intersection: the counter minor septa are slightly longer, than the other minors. Tabulae slightly inclined downwards to epitheca.

Ontogeny—In the neanic stage (as pl. 56, fig. 3a, at 4.5 mm. diam. and with 20 septa, 5 KL, 4 CL) the septa are straight, rhopaloid and radially arranged with the counter septum slightly smaller. The septa join axially to form a wide stereocolumn. This structure is also that of a section (B.M. R34641b) at 6.5 mm. diameter and with 21 septa, except that the counter minors are evident.

PERMIA CARBONARIA Hudson, n. sp.
Plate 56, figures 4a–d, 6

Holotype—Transverse sections B.M. R34640a–d, figured pl. 56, figs. 4a–d.

Paratype—?B.M. R34656.

Description—Corallum slightly curved and slenderly trochoid, about 18 mm. long and 10 mm.; wide; epitheca with fine growth annulations. About 20 straight, rhopaloid, major septa (5 KL, 4 CL) with length about four-fifths corallum radius; counter slightly shorter and cardinal less rhopaloid than others. Septa radial, in contact axially and reinforced by stereome to form a stereotheca with internal diameter about 1.5 mm. and external diameter about 4 mm. Minor septa contratingent and a third to a half length of major septa except counter minors which are about two-thirds length of majors. Cardinal fossulae distinguished by depressed tabulae; no alar fossulae. Tabulae slightly conical; no axial tabulae.

Ontogeny—The axial tube starts at a very early growth-stage. In the brephic stage (septa K, C) and probably in the transitional stage (septa K, KL1, CL1, C) the septa join axially but immediately after, at the stage with ten septa (pl. 56, fig. 4a; 2 by 2.5 mm. diam.; septa K, KL1–2, CL1–2, C), the axial tube, oval in cross section, is a marked feature of the structure being about 0.4 by 0.7 mm. in diameter.

The section, 3.7 by 4.4 mm. diameter, figured on plate 56 figure 4b is difficult to orient. There are apparently 16 major septa (4 KL, 3 CL) and at least one of the counter minors is well developed. The axial tube is about 1.3 mm. diameter. In the late neanic stage (pl. 56, fig. 4c, 6 mm. diam., septa K, km, KL1–5, CL1–4, C) the interseptal loculi are open and the stereotheca is well formed with 1 mm. internal and 2.8 mm. external diameter. The counter minors are as long as the counter septum though the other minors are still embedded in the peripheral stereozone. Thin tabulae are developed. All the minor septa appear together towards the end of the neanic stage. At first they are short and are in contact throughout their length with the adjacent major on the counter side. They then become inclined to the major and separated from it by an open loculus. Later they are curved and then sharply bent to the major septum, the peripheral part being straight. Finally, this straight part becomes a free minor septum or is only attached by a thin dissepiment-like plate as in contrajunct septa.

Remarks—This species differs from *Permia caverna* by the smaller, thinner and straighter corallum. Its stereotheca commences much earlier in the growth of the individual and the minor septa are longer and contratingent, the counter minors being very long. *Permia caverna* is very similar to *P. iwanowi;* the latter has more septa and a smaller and thinner stereotheca which possibly commences earlier in ontogeny. Further knowledge may show that they are the same species.

STRUCTURAL DEVELOPMENT OF PERMIA SPP.

Since little is known of possibly related species from the same or other horizons, little can be inferred as to the phylogeny of these two species or even of the morphogenetic relation. They may be members of the same species plexus: if so, the difference in size and shape suggests that *P. caverna* is morphologically earlier than *P. carbonaria*. In that

case the stereotheca is a deuterogenetic structure and the contratingent septa of *P. carbonaria* are a morphological advance from the free septa of *P. caverna;* this is, however, unlikely. Whatever the relation of the two species, the sequence stereocolumn to stereotheca in the ontogeny of *P. caverna* is probably a palingenetic one, indicating the descent from a form with a rotiphylloid septal plan.

Louis B. Smyth, of Trinity College, Dublin, lent the author the figured section of *Rotiphyllum rushianum* (Vaughan); W. H. T. Tams of the British Museum of Natural History took the photographs of the sections; Geoffrey Cotton read the MS., and R. C. Moore of the University of Kansas corrected proofs and saw the paper through the press: to them the author records his sincere thanks.

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JOURNAL OF PALEONTOLOGY, VOL. 18, NO. 4, PP. 363–365, PLS. 58, 59, JULY 1944

TRILOBITE GENERA GOLDIUS AND ARCTINURUS IN THE SILURIAN OF IOWA AND ILLINOIS

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ABSTRACT—An ontogenetic series of *Goldius laphami* from the Hopkinton dolomite of central-eastern Iowa is illustrated and described. Also, an exceptionally well preserved trilobite pygidium from the Joliet dolomite of Illinois is figured, and the name *Arctinurus thompsoni* is proposed for it and several conspecific specimens from the same formation.

RECENTLY Mr. F. O. Thompson of Des Moines and Mr. Wallace E. Mosely of Anamosa, Iowa, presented two exceptional trilobite pygidia to the State University of Iowa, and Mr. T. D. Shipton of Hanover, Illinois, loaned us a third. These specimens are referable to the genera *Goldius* and *Arctinurus*, and together with related material already in the University's collections they constitute the basis of this study.

Raymond pointed out in 1913 that the generic term *Goldius*, which was proposed by de Koninck in 1841, has priority over *Bronteus* Goldfuss, 1843, a term that was substituted for *Brontes* of the same author when it was found that the latter appellation was preoccupied. *Bronteus* Rafinesque, 1815, apparently is a *nomen nudum*, and has no bearing on the case. The genotype of *Goldius* is *Brontes flabellifer* Goldfuss of the Niagaran of Bessels Bay in northwestern Greenland. Congeneric forms are known from both Europe and North America, and they range in age from Ordovician to Devonian. In the Silurian of America they occur at several widely separated localities in Canada and central United States. Most of them are only of moderate size, but long ago Whitfield described and illustrated a large form, *Goldius laphami*, from the Racine dolomite at Kewaunee, Wisconsin. Our larger specimens differ materially from Whitfield's only in that the pygidial portion of the axial lobe does not seem to be precisely similar in shape, but presumably all are conspecific. Also, we have several smaller specimens from the Hopkinton dolomite of central-eastern Iowa, which yielded our large individuals, and we are regarding them as immature representatives of the same species.

The smallest of these (pl. 58, fig. 3) is only about 22 mm. long and about 23 mm. wide. It differs from the large pygidia particularly in that its central rib does not bifurcate. Also, the axial lobe of this specimen is relatively short and broad. The somewhat larger specimen represented by figure 4 on plate 58 shows that by the time some pygidia had attained a length of about 40 mm. the posterior two-fifths of the central rib had become incipiently bifid. Whitfield figured a pygidium about 50 mm. long which shows a similar but somewhat better developed bifurcation. However, the specimens represented by figures 5 and 6 on plate 58, which are of the same general size as Whitfield's, show no trace of a median groove in the central rib. These latter specimens represent the exterior of the test, whereas all our others (and those of Whitfield) are internal molds, and perhaps this fact will explain the apparent discrepancy in the appearance of bifurcation. The external surface of the test is finely papillose, and on it the radiating ribs of the pygidium show no trace of the transverse rugae that are so prominent on the larger internal molds (pl. 59, figs. 1, 2).

Even a casual examination of the sequence of specimens illustrated shows that during ontogenetic development the general proportions of the pygidium remain essentially constant, but the pygidial portion of the axial lobe becomes relatively long and narrow. It should be stated clearly that all nine of the specimens studied by us came from the Hopkinton dolomite of central-eastern Iowa and that the Hopkinton is of almost the same age as the Racine dolomite of Wisconsin, which yielded Whitfield's type specimens.

The congeneric forms from the Ordovician

of Missouri and New Jersey that Weller (1903, pl. 15, figs. 14, 15) illustrated as *Bronteus lunatus* Billings do not have a divided central rib on the pygidium as does the type specimen of *B. lunatus*, which came from the Ordovician of southeastern Canada, and the supposedly conspecific specimens from the Ordovician of Minnesota. However, it seems quite likely that as Clarke (1897, p. 726) mentioned, the bifurcation of this rib is of "minor significance," and, furthermore, Weller's specimens are probably not conspecific with each other or with that illustrated by Billings.

The genus *Arctinurus* Castelnau, with *Paradoxus boltoni* Bigsby as genotype, occurs in the Ordovician and Silurian of both North America and Europe. The several specimens that have been illustrated as *A. boltoni* and Hall's variety *occidentalis* show a considerable amount of variation, and it is difficult to determine how much latitude should be allowed this species. For some time authors have recognized that the forms from the Waldron shale of Indiana, for which the varietal name *occidentalis* was proposed, should be recognized as specifically distinct from the New York type, which came from the Rochester shale. These Waldron forms differ particularly in that the anterior end of the pygidium is almost straight and the anterolateral zones are almost subangular rather than evenly rounded.

In 1907 Weller illustrated two pygidia from the Joliet dolomite near Bonfield and Joliet, Illinois, which he referred to the Waldron species. Eight years later Bassler apparently recognized that a specimen from the Joliet near Grafton, Illinois, illustrated by Worthen and Meek in 1875 should be associated with the specimens figured by Weller, and he therefore referred it to *A. occidentalis* (though at the same time he inadvertently left it in *A. boltoni*).

All of the New York specimens have been illustrated by drawings rather than by photographs, and this fact may explain in part at least their apparent differences. After carefully comparing the specimen represented by figures 1 and 2 on plate 58 with the various illustrations that have been published, we have concluded that the three Joliet specimens illustrated by Worthen and Meek and by Weller are very close to the one we are studying, but that these forms different considerably from the New York type illustrated by Bigsby. We are therefore proposing for the Joliet specimens the name *A. thompsoni*, in honor of Mr. F. O. Thompson of Des Moines, who collected the specimen under consideration; and we are designating as the holotype of the new species the first representative of it to be illustrated, that is, the one figured by Worten and Meek in 1875.

Superficially, at least, *A. thompsoni* resembles *A. boltoni* more closely than it does *A. occidentalis*, for the anterior margin of its pygidium is not straight and its anterolateral zones are broadly rounded. It differs from the holotype of *A. boltoni*, which came from near Lockport, New York, particularly in the size and shape of the pygidial portion of the axial lobe and the posterior serrations of the pygidium. However, it should be mentioned that the representative of *A. boltoni* from the Rochester shale of western New York that was illustrated by Hall (1852, pl. 70, fig. 1g) seems to resemble *A. thompsoni* more closely than does Bigsby's type; nevertheless, it differs in the length of the pygidial portion of the axial lobe and in the

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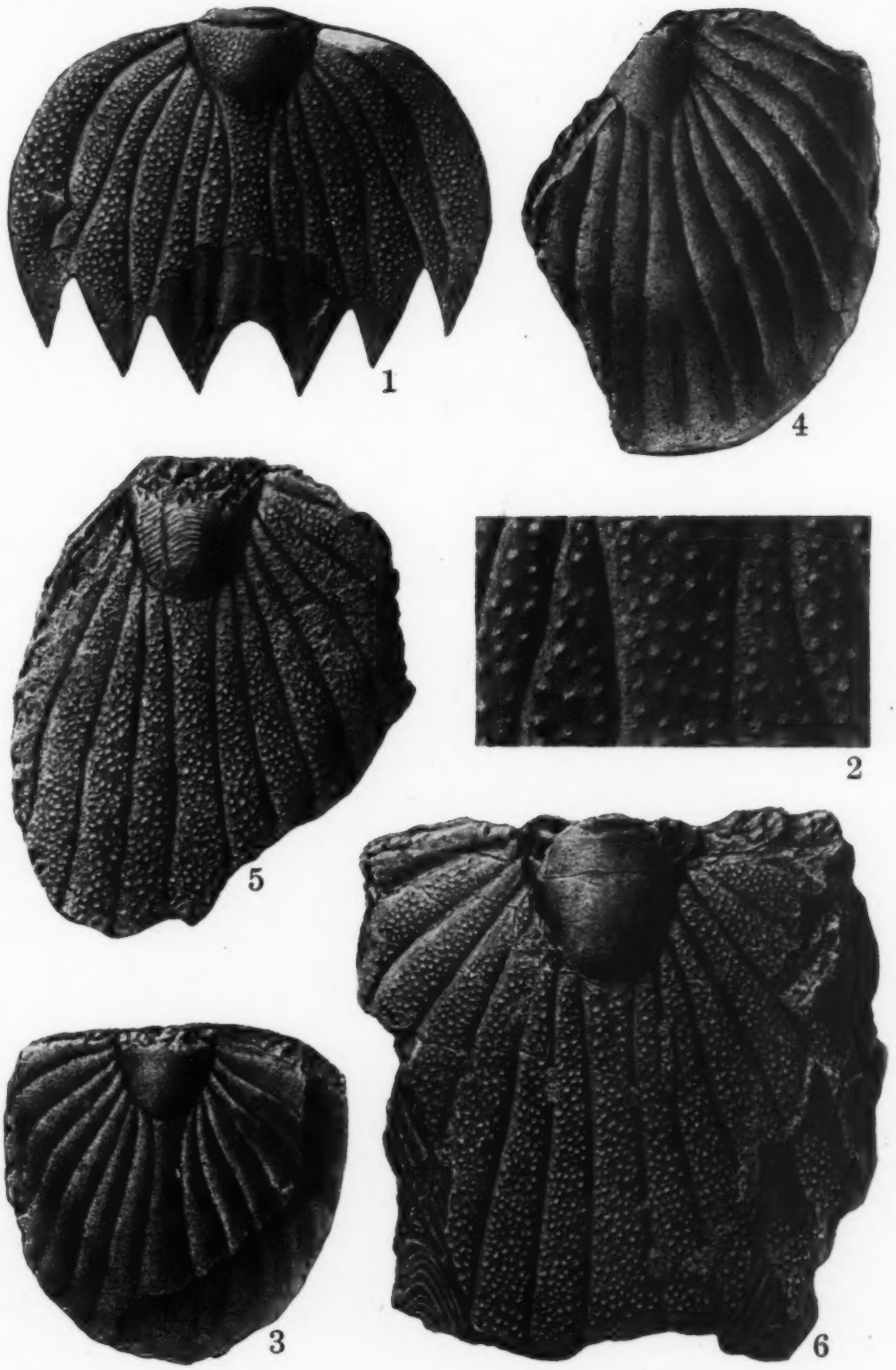
EXPLANATION OF PLATE 58

FIGS. *1, 2*—*Arctinurus thompsoni* Miller and Unklesbay, n. sp. A well-preserved mature pygidium, ×1, and an enlargement, ×3, of a median portion of the same specimen; from a boulder of Joliet dolomite near Coal City, Illinois. State University of Iowa, 2111.

3–6—*Goldius laphami* (Whitfield). Four pygidia from the Hopkinton dolomite of central-eastern Iowa, illustrating various stages of ontogenetic development. Figure *3* is ×2, and the specimen it represents (State University of Iowa, 9048) came from near Central City. Figures *4*, *5*, and *6* are all ×1¼. They are at the State University of Iowa, numbered 9052, 9050, and 9049, respectively—the first (fig. *4*) is from sec. 20, Coffins Grove Township, Delaware County; the other two (figs. *5*, *6*) are from near Clinton.



Miller and Unklesbay—Silurian trilobites

Miller and Unklesbay—Silurian trilobites

details of the posterior serrations and the radial markings on the pygidium.

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MANUSCRIPT RECEIVED MAY 1, 1942.

EXPLANATION OF PLATE 59

FIGS. *1, 2*—*Goldius laphami* (Whitfield). Two large mature pygidia, ×1, collected by Wallace E. Mosely from the Hopkinton dolomite of central-eastern Iowa. The speicmen represented by figure *1* came from a quarry about a third of a mile west of Central City and is now in the private collection of T. D. Shipton of Hanover, Illinois. That represented by figure *2* was found in the Rockdale quarry about 1 mile northeast of Maquoketa, Iowa, and is now in the collections of the State University of Iowa, numbered 9592.

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EOCENE FORAMINIFERA FROM CAPE BLANCO, OREGON

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ABSTRACT—Gray shale occurring at Cape Blanco, Oregon, has yielded an Eocene foraminiferal fauna of 33 species. One genus and eleven species are new.

INTRODUCTION

GRAY shale containing a fairly abundant microfauna, but completely without macrofossils, outcrops on the south side of Cape Blanco, Oregon. The shale extends from this outcrop northward through the Cape and again outcrops along the sea cliff continuously to the mouth of Sixes River. The structure of these beds is not known because of their weathered and slumped condition. Southward the shale is bounded by Pliocene Empire sandstone. The contact is obscured but it is probably a fault. On the west is a serpentinous mass which in turn is faulted against the basal Empire beds composing most of the outer portion of the Cape. Unconformably overlying the older formations are Pleistocene terrace deposits. Diller[1] mapped the gray shale questionably as the Myrtle formation of Cretaceous age. This identification was based on the general lithologic similarity of this material to the Myrtle and its proximity to outcrops of that formation.

FAUNAL CONSIDERATIONS

In its general aspect the microfauna of the gray shale is strikingly similar to Eocene faunas of the Eastern Coastal Plain. Although several species are not the same, they are homeomorphs. The most abundant and highly specialized form in the fauna is *Amphistegina simiensis* (Cushman and McMasters) which is common in the Middle Eocene of California. The table shows that the greater number of species is common to the Lower and Middle Eocene but as the more abundant and highly specialized species are found in the Middle Eocene, that is the indicated age of the fauna. This conclusion is reasonable from a paleographical standpoint and suggests the existence of a southward extension of the sea in which the Arago formation was deposited.

[1] Diller. J. S. U. G. S. Bull. 196, 1902.

ACKNOWLEDGEMENTS

The writer is greatly indebted to Dr. J. J. Galloway, Professor of Geology at Indiana University, for his constructive criticism and his supervision and assistance in shading the figures. To Dean E. L. Packard of Oregon State College many thanks are due for invaluable advice.

All of the types are catalogued and deposited in the Paleontological Laboratory of Indiana University.

QUINQUELOCULINA LAEVIGATA d'Orbigny
Plate 60, figures 1a–c

Quinqueloculina laevigata d'Orbigny, 1826, Annals sci. nat., vol. 7, No. 6, p. 301; Middle Eocene, Paris Basin; in Barker, Webb, and Berthelot, 1839, Hist. Nat. Isles Canaries, vol. 2, pt. 2, Foram., p. 143, pl. 3, figs. 31–33; Recent Canaries.—Cushman, 1935, U. S. Geol. Survey Prof. Paper 181, p. 11, pl. 2, figs. 13–15; Upper Eocene, Mississippi.—Cushman and McMasters, 1936, Jour. Paleontology, vol. 10, pp. 509–510, pl. 74, fig. 7; middle Eocene, California.—Galloway and Heminway, 1941, New York Acad. Sci., Sci. Survey Porto Rico and the Virgin Islands, vol. 3, pt. 4, pp. 302–303, pl. 1, figs. 8a–c; Middle Oligocene, Porto Rico.

Test elongate; edge rounded; chambers well defined, somewhat inflated; sutures depressed; aperture terminal, extended, circular, length 0.60 mm., width 0.34 mm., thickness 0.12 mm. Common.

Plesiotype, no. 4585.

TRILOCULINA LAEVIGATA d'Orbigny
Plate 60, figures 2a–c

Triloculina laevigata d'Orbigny, 1826, Annals sci. nat., vol. 7, p. 300, no. 15; Recent, Medi-

STRATIGRAPHIC RANGES OF SPECIES

	Cretaceous	Lower Eocene	Middle Eocene	Upper Eocene	Lower Oligocene	Middle Oligocene	Upper Oligocene	Lower Miocene	Middle Miocene	Upper Miocene	Pliocene	Pleistocene	Recent
Amphistegina simiensis			×										
Anomalina packardi													
Astacolus subtumidus													
Bulimina ampla		×	×	×									
Bulimina pupoides	×	×	×	×	×	×	×	×	×	×	×	×	×
Cibicides celebrus		×	×	×									
Cibicides howelli		×											
Cibicides lobatus				×	×	×	×	×	×	×	×	×	×
Cibicides mexicanus		×	×	×	×	×	×						
Cibicides perlucidus				×	×	×	×	×					
Glandulina elliptica					×	×	×						
Globigerina eocaenica		×	×	×	×	×	×						
Globigerina quadripartita		×	×	×	×	×	×	×	×	×			
Globigerina trilocularis		×	×	×	×	×	×	×	×				
Globorotalia lotus		×	×										
Guttulina oregonensis													
Lagena williamsoni											×	×	×
Lamarckina rugatina													
Marginulinopsis cingulosa													
Marginulinopsis prolata													
Nodosaria consobrina		×	×	×	×	×	×	×	×	×			
Nonion planatum		×	×	×									
Quinqueloculina laevigata			×	×		×							×
Robulus americanus									×	×			
Robulus degolyeri		×											
Robulus texanus		×	×	×									
Rotorbinella colliculus													
Saracenaria blancoensis													
Spiroplectammina adamsi		×											
Triloculina laevigata						×	×	×					×
Valvulineria cooperensis		×	×	×									
Valvulineria lottensis		×											
Valvulineria patelliformis													
Number of species	1	16	14	14	9	11	10	7	6	5	3	3	5

terranean.—Fornasini, 1905, R. accad. sci. Instit. Bologna Sez. sci. nat. Mem., ser. 6, vol. 2, p. 61, pl. 1, fig. 10 (from d'Orbigny's unpublished figure).—Galloway and Heminway, 1941, New York Acad. Sci., Sci. Survey of Porto Rico and the Virgin Islands, vol. 3, pt. 4, p. 308, pl. 3, figs. 6a–c; Middle Oligocene to Lower Miocene, Porto Rico.

Test elongate, subelliptical in side view, ovate in cross section; edge round; chambers elongate, slightly tapering toward apertural end, nearly equidimensional in transverse section; sutures distinct, slightly depressed; aperture terminal with bifid tooth. Length, 0.88 mm.; breadth, 0.50 mm.; thickness, 0.28 mm.; common.

Remarks—Tests of the Cape Blanco specimens are poorly preserved, in many cases the internal mold is all that remains.

Plesiotype, no. 4592.

SPIROPLECTAMMINA ADAMSI Lalicker
Plate 60, figures 3a, b

Spiroplectammina adamsi Lalicker, 1935, Cushman Lab. Foram. Res. Contr., vol. 11, pt. 2, pp. 39–40, pl. 6, figs. 1–2; Eocene, Martinez formation, California.

Test cuneiform in side view, subrhomboidal in apertural view, thickest along central portion; edge sharp; periphery ir-

regular; early chambers planispiral, later ones biserial; sutures distinct, slightly curved, oblique with conspicuous parallel costae resulting from collapse of chambers; surface finely arenaceous with much cement; aperture at inner margin of last chamber in a distinct reëntrant. Length, 0.55 mm.; breadth, 0.35 mm.; thickness, 0.22 mm.; rare.

Plesiotype, no. 4591.

ROBULUS AMERICANUS (Cushman)
Plate 60, figures 4a, b

Cristellaria americana Cushman, 1918, U. S. Geol. Survey Bull. 676, p. 50, pl. 10, figs. 5 and 6; Middle and Upper Miocene, South Carolina, Florida.

Test circular, very strongly biconvex, with prominent, flat umbonal regions; whorls narrow, strongly involute; edge with sharp, narrow keel; periphery entire; chambers 7 in last whorl, enlarging gradually; sutures straight, tangential to umbos thickened, raised, becoming higher as they join umbos; surface smooth; wall finely perforate; aperture produced, on peripheral margin of septal face, elongate, radiate, with narrow slit extending down to near base of septal face. Diameter, 1.2 mm.; thickness, 0.70 mm.; common.

The identification of this species is doubtful because the thickness and apertural characters are not given in the original description and figures.

Plesiotype, no. 4587.

ROBULUS DEGOLYERI (Plummer)
Plate 60, figures 5a,b

Cristellaria degolyeri Plummer, 1927, Texas Univ. Bull. 2644, p. 97, pl. 7, figs. 7a–b; Lower Eocene, Texas.

Test oval, longer than broad, moderately biconvex; edge sharp, bounded by strong carina which is usually broken and ragged; chambers 7–9 in last whorl; sutures curved especially toward periphery, marked by strong raised ridges which end in conspicuous umbo, last two sutures become less conspicuous and even flush with surface; aperture at outer margin of last septal face, radiate, elongate. Diameter 0.98 by 0.80 mm., thickness 0.51 mm. Rare.

This form differs from "*Cristellaria*" *midwayensis* var. *carinata* Plummer (Texas Univ. Bull. 2644, 1927) mainly in being oval rather than circular.

Plesiotype, no. 4586.

ROBULUS TEXANUS (Cushman and Applin)
Plate 60, figures 6a, b

Cristellaria articulata texana Cushman and Applin, 1926, Am. Assoc. Petroleum Geologists Bull., vol. 10, no. 2, p. 170, pl. 8, figs. 1 and 2; Upper Eocene, Jackson formation, Texas.—Ellisor, 1933, idem, vol. 17, pl. 2, fig. 3; Upper Eocene, Jackson group, Texas.

Robulus articulatus texanus, Cushman and Applin, 1934, Cushman Lab. Foram. Res. Contr., vol. 10, pt. 3, p. 53, pl. 7, figs. 2–3; Eocene, Poway group, California.

Test subcircular, moderately biconvex; periphery entire with narrow keel of clear shell material; chambers of previous whorls visible through clear umbonal thickening; chambers 8–11 in last whorl, enlarging gradually; sutures flush with surface, bordered by narrow bands of clear shell material; septal face small, oval; aperture at outer margin of last septal face, radiate, with narrow slit extending short distance down septal face. Diameter, 0.75 mm.; thickness, 0.35 mm.; very common.

Plesiotype, no. 4588.

ASTACOLUS SUBTUMIDUS Bandy, n. sp.
Plate 60, figures 7a, b

Test elongate, compressed above large megaspheric proloculum; early chambers planispiral, last two chambers evolute; edge sharply rounded; chambers 8 to 10 visible, increasing slightly in length as added; sutures distinct, appearing broad through clear wall, flush with surface; surface smooth; aperture terminal on outer margin of last chamber, large, oval, radial. Length, 0.60 mm.; breadth, 0.32 mm.; thickness, 0.17 mm.; rare.

This species differs from *A. crepidula* (Fichtel and Moll) (Test. Micr., 1798) in being relatively less elongate, thicker, and broader.

Holotype, no. 4565.

SARACENARIA BLANCOENSIS Bandy, n. sp.
Plate 60, figures 8a, b

Test elongate, early portion compressed above megaspheric proloculum, later portion triangular in transverse section; edge sharply rounded; periphery entire; chambers closely

appressed, early chambers coiled, later chambers evolute extending on inner margin toward early coiled part; sutures flush with surface; wall smooth; apertural face fairly broad, slightly concave; aperture radial, with remnant of robuline slit, terminal on outer margin of last chamber. Length, 0.49 mm.; breadth, 0.20 mm.; thickness, 0.15 mm.; rare.

Remarks.—This new species differs from *"Cristellaria" inclinata* Reuss (Beitrage zur Kenntniss der Tert. Foram.-Fauna, Sitz. k. Ak. Wiss. Wien, vol. 48, 1863), in being comparatively broader with a concave apertural face. It differs from *"Cristellaria" tripleura* Reuss (K. Akad. Wiss. Wien Math.-naturh. Kl., Sitzungsber., 1860, Bd. 40) in being of even breadth, more compressed in the early portion, and with a concave apertural face.

Holotype, no. 4590.

MARGINULINOPSIS CINGULOSA Bandy, n. sp.
Plate 60, figures 9a, b

Test moderately elongate, early part planispiral, compressed, becoming evolute and cylindrical in later part; later chambers increasingly inflated as added; edge acute with thin irregular keel in early part, rounded in later portion; sutures in planispiral portion raised, beaded, becoming annular and ridge-like in evolute portion; chambers about 7 in spiral part, about 4 in evolute part; wall smooth excepting for beaded sutures, sutural ridges and knobs on back of test between sutures; aperture in adult specimens terminal, round, simple, in younger specimens on outer edge of last chamber, round and radiate. Length, 0.93 mm.; breadth of last chamber, 0.33 mm.; breadth of planispiral portion, 0.44 mm.; thickness of planispiral portion, 0.22 mm.; of the latest portion 0.3 mm.; fairly common.

This species differs from *Cristellaria fragaria texasensis* Cushman and Applin (Am. Assoc. Petroleum Geologists, Bull., vol. 10, 1926) in the more finely beaded sutures in the early portion of the test, the raised annual ridges in the later portion, and in the greater inflation of the last few chambers. This form is also similar to *Cristellaria subaculeata tuberculata* Plummer (Texas Univ. Bull. 2644, 1926.)

Holotype no. 4581.

MARGINULINOPSIS PROLATA Bandy, n. sp.
Plate 60, figures 10a, b

Test elongate, slender, early portion planispiral, compressed, later rectilinear portion composed of about 4 chambers; edge of coiled portion acute, with slight keel, back of evolute part rounded; sutures gently curved, raised in early part, broad and depressed in evolute portion; wall finely perforate; surface near proloculum covered with small low knobs, surface of evolute part with round, shallow, regularly arranged depressions; aperture produced, terminal, simple. Length, 1.00 mm.; width of the planispiral part, 0.30 mm.; rare.

Holotype, no. 4582.

GLANDULINA ELLIPTICA Reuss
Plate 60, figures 11a, b

Glandulina elliptica Reuss, 1863, K. Akad. Wiss. Wien, Math.-naturh. Kl., Sitzungsber., Wien, Osterreich, Bd. 48, Abt. 1, p. 47, pl. 3, figs. 29–31; Oligocene, Germany.

Test elongate ovate, round in transverse section, initial end bluntly or broadly rounded, other end tapering evenly to aperture; chambers about 4, uniserial, much overlapping; sutures flush, last one sometimes very slightly depressed; surface smooth; aperture radiate, terminal. Length, 0.50 mm.; diameter, 0.26 mm.; rare.

Plesiotype, no. 4573.

NODOSARIA CONSOBRINA (d'Orbigny)
Plate 60, figure 12

Dentalina consobrina d'Orbigny, 1846, Foram. Foss. Bass. Tert. Vienne, p. 46, pl. 2, figs. 1–3. Miocene, Vienna.
Dentalina consobrina, Cushman and Barksdale, 1930, Stanford Univ. Dept. Geology Contr., vol. 1, p. 64, pl. 11, figs. 9–10; Eocene, California.

Test circular in cross section, the two chambers of unequal length, slightly inflated; sutures depressed; surface smooth; aperture terminal, radial. Length of broken plesiotype 0.80 mm., diameter 0.25 mm. Common.

Plesiotype, no. 4583.

LEGENA WILLIAMSONI (Alcock)
Plate 60, figure 13

Entosolenia williamsoni Alcock, 1865, Lit. Philos. Soc. Proc.,,vol. 4, p. 193; Recent, Britain.
Lagena williamsoni, Wright 1876–1877, Belfast

Nat. Field Club Proc.—Cushman, 1923, U. S. Nat. Mus. Bull. 104, pt. 4, p. 61, pl. 11, figs. 8–9; Recent, Ireland.—Cushman, 1929, Cushman Lab. Foram. Res. Contr., vol. 5, p. 70, pl. 11, figs. 7–8; Pliocene, California.—Cushman, Stewart and Stewart, 1930, San Diego Soc. Nat. History Trans., vol. 6, no. 2, p. 59, pl. 8, fig. 5; Pliocene, California.

Test pyriform; apertural end tapering to short neck; basal end broadly rounded; wall ornamented with 14–16 longitudinal costae coalescing just below aperture to form collar bearing 3 rings of hexagonal reticulations. Length, 0.30 mm.; diameter, 0.19 mm.; rare.

Plesiotype, no. 4579.

GUTTULINA OREGONENSIS Bandy, n. sp.
Plate 60, figures 14a, b

Test subtriangular in side view, maximum width slightly above center, initial end with five elongate, inflated chambers to the whorl, apertural end broadly rounded with two elongated but only moderately inflated chambers to the whorl; early sutures much depressed, later sutures nearly flush; surface smooth, very finely perforate; aperture terminal, radiate, elliptical. Length, 0.44 mm.; breadth, 0.41 mm.; thickness, 0.31 mm.; rare.

This species is very similar to *Guttulina bulloides*, Cushman and Ozawa (U. S. Nat. Mus. Proc., vol. 77, art. 6, 1930) but bears little resemblance to the original *Polymorphina bulloides* Reuss. It differs from *G. communis* d'Orbigny in its blunt apertural end and elliptical aperture. *G. problema* d'Orbigny is a more elongate form with loosely appressed chambers. *Guttulina irregularis* (d'Orbigny) (Foram. Foss. Bass. Tert. Vienne, 1846) is more acute at the apical end with the maximum breadth below center.

Holotype, no. 4578.

NONION PLANATUM Cushman and Thomas
Plate 60, figures 15a–c

Nonion planatum Cushman and Thomas, 1930, Jour. Paleontology, vol. 4, p. 37, pl. 3, figs. 5a, b; Middle Eocene, Texas.—Cushman and Dusenbury, 1934, Cushman Lab. Foram. Research Contr., vol. 10, p. 60, pl. 8, figs. 6a, b; Eocene, Poway conglomerate, California.—Cushman, 1939, U. S. Geol. Survey, Prof. Paper 191, pp. 4–5, pl. 1, fig. 15; Eocene, Alabama, Mississippi, Texas.

Test nearly bilaterally symmetrical, biumbilicate, umbilici deep, surrounded by rims of clear shell material continuous with sutures; back smoothly rounded; periphery very slightly lobulate in last half whorl, early portion entire; chambers 9–10 in final whorl, gradually increasing in size; sutures flush, slightly depressed, gently curved, limbate, widening slightly toward umbilici; surface smooth, finely but distinctly perforate; aperture a very low arch at base of septal face. Diameter, 0.48 mm.; thickness, 0.20 mm.; very common.

This form might be mistaken for an *Anomalina*, e.g. *A. dibollensis* Cushman and Applin (U. S. Geol. Survey Prof. Pap. 181, 1935, p. 50) but the fine pores, the nearly equal umbilici and the almost planispiral symmetry show that it is *Nonion* and not *Anomalina*.

Plesiotype, no. 4584.

GLOBOROTALIA LOTUS (Schwager)
Plate 61, figures 1a–c

Pulvinulina lotus Schwager, 1883, Palaeontographica, vol. 30, Pal. Theil, p. 132, pl. 28 (5), figs. 9a–c; Middle Eocene, Northern Africa.

Eponides lotus, Cushman and Ponton, 1932, Cushman Lab. Foram. Res. Contr., vol. 8, p. 71, pl. 9, figs. 8a–c; Lower Eocene, Wilcox, Alabama.—Cushman and Garrett, 1939, Cushman Lab. Foram. Res. Contr., vol. 15, pp. 85–86, pl. 15, figs. 3–6; Eocene, Wilcox, Alabama.—Israelsky, 1939, Proc. Sixth Pacific Sci. Congress, p. 578, pl. 5, figs. 1–4; pl. 6, fig. 1; Eocene, California.—Cushman and Todd, 1942, Cushman Lab. Foram. Res. Contr., vol. 18, p. 40, pl. 7, figs. 13–14; Lower Eocene, Naheola formation, Alabama.

Test subcircular to oval, dorsal side strongly convex, ventral side moderately convex, umbilicate; edge sharply rounded; periphery slightly lobulate; whorls about 3; chambers 6 in last whorl, increasing gradually in size; ventral sutures slightly curved, moderately depressed; dorsal sutures flush, slightly curved, tangential to previous whorl; surface smooth, central portion of dorsal surface covered with thin pellicle of secondary material with occasional pustules; pores fine but conspicuous; aperture a slit, without upper lip, at base of last septal face, extending from near periphery into umbilicus. Diameter, 0.55 mm.; thickness, 0.31 mm.; rare.

Schwager's original figure of this species shows a narrow aperture extending from

near the periphery into the umbilicus, hence this form belongs in the genus *Globorotalia* rather than *Eponides*.

Plesiotype, no. 4577.

LAMARCKINA RUGATINA Bandy, n. sp.
Plate 61, figures 2a–c

Test thick, longer than broad; dorsal side strongly convex with nearly flat spine; ventral side somewhat convex, with large umbilicus; edge angular, carinate in early portion of last whorl, with broad back in later portion; periphery slightly lobulate in last part of final whorl, otherwise entire; chambers 8 to 9 in last whorl, rapidly increasing in size, last 2 or 3 inflated; dorsal sutures, with prominent raised ridges between whorls and between chambers, ventral sutures flush; surface smooth; wall finely perforate; aperture opening into umbilicus, with lobes extending into septal face. Diameter, 0.66 mm.; thickness, 0.45 mm.; rare.

This form is very similar to *L. marylandica* Cushman (Cushman, Lab. Foram. Res. Contr., vol. 2, 1926) but differs mainly in the more rapid increase in the size of chambers of the last whorl, the less curved sutures, and the thicker test, with flattened spire. *L. limbata* Cushman and Todd (Cushman Lab. Foram. Res. Contr., vol. 18, 1942) is much smaller, has a roughened dorsal surface and has fewer chambers.

Holotype, no. 4580.

VALVULINERIA COOPERENSIS (Cushman)
Plate 61, figures 3a–c

Cibicides cooperensis Cushman, 1933, Cushman Lab. Foram. Res. Contr., vol. 9, p. 20, pl. 2, figs. 11a–c; Eocene, Jackson, South Carolina.—1935, U. S. Geol. Survey Prof. Paper 181, p. 53, pl. 23, figs. 3a–c; Eocene, South Carolina.

Test subcircular, unequal biconvex, dorsal side more convex, almost completely involute, umbilicate, ventral side only slightly convex, with valvular extensions of last few chambers covering umbilicus; edge rounded, blunter in later portion; periphery slightly lobulate; chambers 8 to 9 in last whorl, rapidly increasing in size, later ones somewhat inflated; sutures curved, early ones slightly limbate, later ones depressed; surface smooth, distinctly perforate, with medium-sized pores; aperture at ventral side of base of last septal face, extending into umbilicus under valvular lips of last few chambers. Diameter up to 0.90 mm. in gerontic specimens, figured specimen 0.55 mm.; thickness, 0.28 mm.; abundant.

This species is not a *Cibicides* but a typical *Valvulineria*. It differs from *Valvulineria depressa* Cushman (Cushman Lab. Foram. Res. Contr., vol. 2, p. 61, 1926) in being unequally biconvex throughout.

Plesiotype, no. 4593.

VALVULINERIA LOTTENSIS (Garrett)
Plate 61, figures 4a–c

Gyroidina lottensis Garrett, 1941, Jour. Paleontology, vol. 15, p. 155, pl. 26, figs. 11a–c; Middle Eocene, Alabama.

Test subcircular to oval in outline; dorsal side broadly convex, early spire raised, covered by secondary thickening of clear shell material; ventral side very convex with umbilical region depressed and small umbilicus; edge round; periphery entire except on last chamber or two where it is slightly lobulate; chambers 8 to 9 in last whorl, very gradually increasing in size; spiral suture depressed between last half-whorl land previous whorl, sutures between chambers curved, flush with surface except for last 2 or 3; surface smooth, polished, very finely perforate; aperture an elongate, narrow arch, extending from periphery into umbilicus, with narrow upper lip, and fragmentary valvular flaps in umbilicus. Diameter, 0.58 mm.; breadth, 0.45 mm.; thickness, 0.32 mm.; common.

Plesiotype, no. 4594.

VALVULINERIA PATELLIFORMIS Bandy, n. sp.
Plate 61, figures 5a–c

Test cap-shaped, dorsal side convex, ventral side concave with marked umbilicus; edge round; periphery nearly entire; earlier whorls visible dorsally, only last whorl visible ventrally; chambers 9 to 10 in last whorl, increasing gradually in size; sutures slightly curved ventrally, much more so dorsally, narrowly limbate on both sides, last few may be slightly depressed; surface smooth; wall finely but conspicuously perforate; aperture at base of septal face, extending

under valvular lip into umbilicus. Length, 0.58 mm.; breadth, 0.48 mm.; thickness, 0.21 mm.; rare.

This species differs from *V. jacksonensis* Cushman (Cushman Lab. Foram. Res. Contr., vol. 9, 1933) in being cap-shaped with a marked umbilicus lacking papillae and with the ventral sutures nearly radial instead of oblique. *Discorbis newmanae* Plummer (1926, Texas Univ. Bull. 2644), differs in being smaller, more compressed, and with fewer chambers.

Holotype, no. 4595.

Genus ROTORBINELLA Bandy, n. gen.

Test free, small, rotaloid, only last whorl visible ventrally, with definite umbilical plug; spire visible dorsally this side usually much more convex than ventral side; chambers numerous, moderately or closely appressed; dorsal sutures flush, usually limbate, ventral sutures depressed, sometimes channeled, at times with reëntrants; wall smooth, very coarsely perforate; aperture a slit at base of septal face not extending onto periphery. Diameter 0.25 to 0.60 mm. Eocene to Recent.

Genotype, *Rotorbinella colliculus* Bandy, n. sp.

Rotorbinella differs from *Discorbis* in possessing an umbilical plug; from *Rotalia* in being very coarsely perforate and in lacking a complex umbilical plug; from *Cibicides* in lacking the dorsal aperture.

The following species and perhaps others should be referred to this genus; *Discorbina rigida* Schwager, *Discorbina semiorbis* Karrer, *Rotalia caloosahatchensis* Cole, *Rotalia rosea* d'Orbigny, and *Rotalia turbinata* Cushman and Valentine. *Rotalia depressa* Natland, a homonym, also belongs in this genus. The original descriptions and figures of the above species are reproduced in the "Catalogue of Foraminifera" Ellis and Messina, American Museum of Natural History, New York, 1940.

ROTORBINELLA COLLICULUS Bandy, n. sp.
Plate 61, figures 6a–c

Test subcircular in side view, hemispherical in edge view, slightly convex ventrally, strongly convex or domed dorsally; edge sharply rounded; periphery smooth or very slightly lobulate with wide nonperforate

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EXPLANATION OF PLATE 60

FIGS. *1—Quinqueloculina laevigata* d'Orbigny. ×40. *a*, Side view; *b*, apertural view; *c*, opposite side view; plesiotype no. 4585. (p. 366)

2—Triloculina laevigata d'Orbigny. ×40; *a*, Side view; *b*, apertural view; *c*, opposite side view; plesiotype no. 4592. (p. 366)

3—Spiroplectammina adamsi Lalicker. ×60. *a*, Apertural view; *b*, side view; plesiotype no. 4591. (p. 367)

4—Robulus americanus (Cushman). ×30. *a*, side view; *b*, apertural view; plesiotype no. 4587. (p. 368)

5—Robulus degolyeri (Plummer). ×30. *a*, Apertural view; *b*, side view; plesiotype no. 4586. (p. 368)

6—Robulus texanus (Cushman and Applin). ×40. *a*, Apertural view; *b*, side view; plesiotype no. 4588. (p. 368)

7—Astacolus subtumidus n. sp. ×80. *a*, Apertural view; *b*, side view; holotype no. 4565 (p. 368)

8—Saracenaria blancoensis n. sp. ×80. *a*, Apertural view; *b*, side view; holotype no. 4590. (p. 368)

9—Marginulinopsis cingulosa n. sp. ×30. *a*, Apertural view; *b*, side view; holotype no. 4581. (p. 369)

10—Marginulinopsis prolata n. sp. ×30. *a*, Apertural view; *b*, side view; holotype no. 4582. (p. 369)

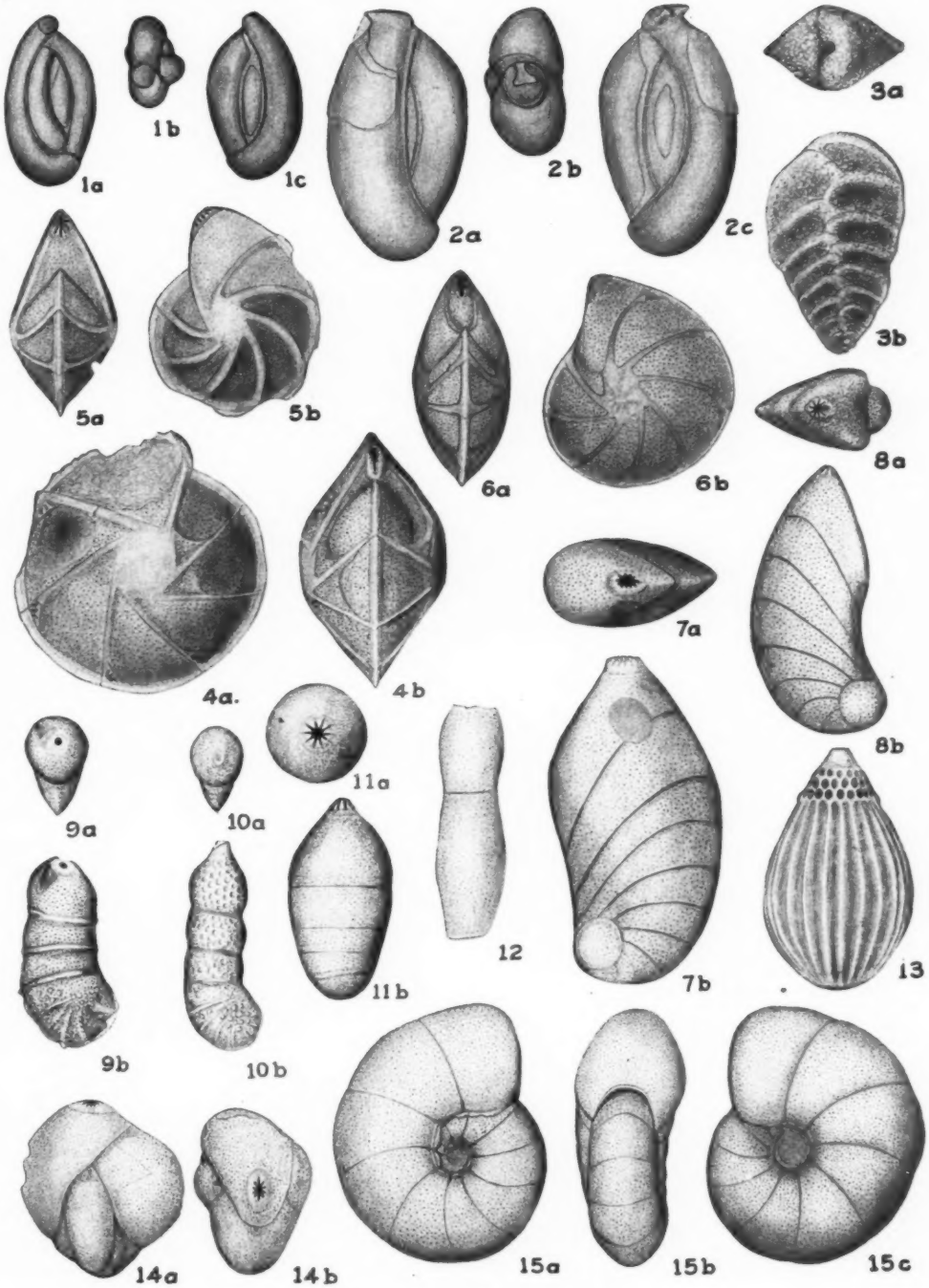
11—Glandulina elliptica Reuss. ×60. *a*, Apertural view; *b*, side view; plesiotype no. 4573. (p. 369)

12—Nodosaria consobrina (d'Orbigny). ×40. plesiotype no. 4583. (p. 369)

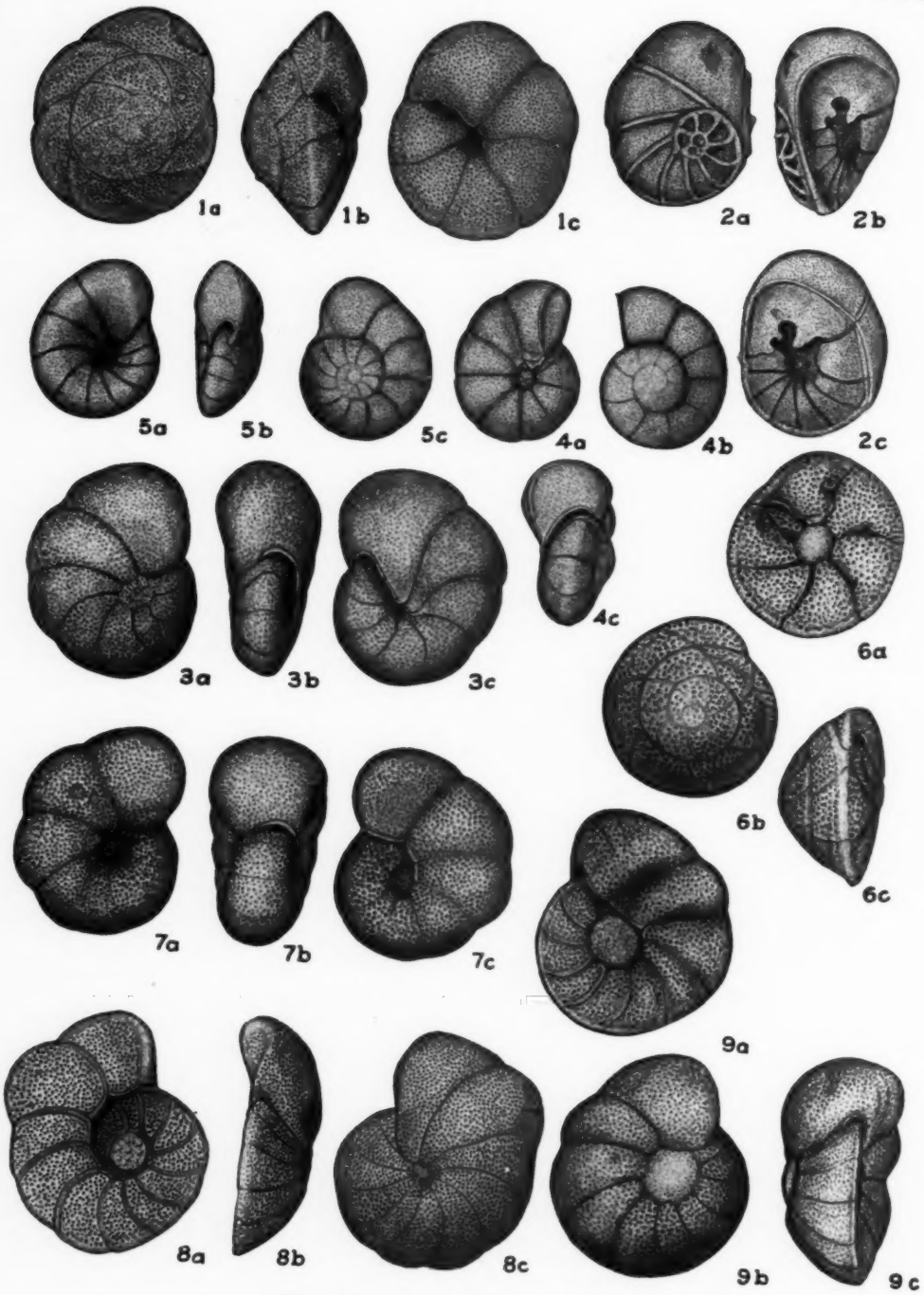
13—Lagena williamsoni (Alcock). ×105. plesiotype no. 4579. (p. 369)

14—Guttulina oregonensis n. sp. ×60. *a*, Side view; *b*, apertural view; holotype no. 4578. (p. 370)

15—Nonion planatum Cushman and Thomas. ×80. *a*, Side view; *b*, apertural view; *c*, opposite side view; plesiotype no. 4584. (p. 370)



Bandy—Eocene Foraminifera



Bandy—Eocene Foraminifera

margin but no keel; chambers 6 in final whorl, increasing very gradually in size as added, uninflated dorsally, closely appressed, ventral chambers slightly inflated; dorsal spire clearly seen except early portion which is partially obscured by secondary thickening; only last whorl visible ventrally; strong umbilical plug composed of clear shell material; dorsal sutures gently curved, somewhat oblique, strongly limbate, flush with surface; ventral sutures gently curved, slightly depressed, deepening toward umbo, with small reëntrant; wall thick, very coarsely perforate both dorsally and ventrally; aperture a slit at base of septal face between periphery and umbilical plug, widest toward periphery. Diameter 0.46 by 0.43 mm., thickness 0.28 mm. Very common.

This species differs from most of its close allies in possessing few chambers. It differs from "*Rotalia*" *caloosahatchensis* Cole (Florida Geol. Survey Bull. 6, 1931) mainly in lacking the carinate periphery and in being relatively much thicker. "*Rotalia*" *turbinata* Cushman and Valentine (Stanford Geol. Dept. Contr., vol. 1, no. 1, 1930) has a very high and convexly domed dorsal side and a much larger ventral umbilical plug than *R. colliculus*.

Holotype, no. 4589.

ANOMALINA PACKARDI n. sp.
Plate 61, figures 7a–c

Test of average size, nearly bilaterally symmetrical, subcircular, biumbilicate, more involute on side opposite aperture where early spire is obscured by secondary material, apertural side with much deeper umbilicus; back broadly rounded; thickness exceeding one-half diameter; chambers gradually enlarging, 7–9 in last whorl, only slightly inflated up to last half whorl where they become strongly inflated; sutures flush up to last 3 or 4 chambers, later ones only slightly curved, depressed; surface even, very coarsely perforate, early portion of last whorl with secondary thickening tending to obscure sutures, obliterating some pores and enlarging others; aperture a low arch at base of one side of last septal face, extending into umbilicus; apertural face broader than high. Diameter of figured specimen 0.73 mm., thickness 0.43 mm. Common.

This form differs from *Anomalina grosserugosa* Gümbel, with which many similar forms have been identified, in that the whorls do not increase as rapidly in height as in Gümbel's species and the test is very nearly bilaterally symmetrical instead of flattened dorsally and deepened ventrally. One of the Recent forms figured by Brady as *A. grosserugosa* (Challenger Rept. vol. 9, pl. 94, fig. 4) bears general similarity to this species but differs in that much of the spire is visible dorsally with the aperture extending on this side a short distance between the last two whorls, ventrally there are only one or two chambers of the previous whorl visible.

This species is named in honor of Dr. E. L.

EXPLANATION OF PLATE 61

FIGS. *1*—*Globorotalia lotus* (Schwager). ×60. *a*, Dorsal view; *b*, edge view; *c*, ventral view; plesiotype no. 4577. (p. 370)

2—*Lamarckina rugatina* n. sp. ×40. *a*, Dorsal view; *b*, edge view; *c*, ventral view; holotype no. 4580. (p. 371)

3—*Valvulineria cooperensis* (Cushman). ×60. *a*, Dorsal view; *b*, edge view; *c*, ventral view; plesiotype no. 4593. (p. 371)

4—*Valvulineria lottensis* (Garrett). ×40. *a*, Ventral view; *b*, dorsal view; *c*, edge view; plesiotype no. 4594. (p. 371)

5—*Valvulineria patelliformis* n. sp. ×40. *a*, Ventral view; *b*, edge view; *c*, dorsal view; holotype no. 4595. (p. 371)

6—*Rotorbinella colliculus* n. sp. ×60. *a*, Ventral view; *b*, dorsal view; *c*, edge view; holotype no. 4589. (p. 372)

7—*Anomalina packardi* n. sp. ×40. *a*, Dorsal view; *b*, edge view; *c*, ventral view; holotype no. 4564. (p. 373)

8—*Cibicides celebrus* n. sp. ×60. *a*, Dorsal view; *b*, edge view; *c*, central view; holotype no. 4568. (p. 374)

9—*Cibicicdes howelli* Toulmin. ×60. *a*, Dorsal view; *b*, ventral view; *c*, edge view; plesiotype no. 4569. (p. 374)

Packard, of Oregon State College, who first aroused my interest in paleontology.

Holotype, no. 4564.

CIBICIDES CELEBRUS Bandy, n. sp.
Plate 61, figures 8a–c

Cibicides sassei, Cushman and Dusenbury, 1934, Cushman Lab. Foram. Res. Contr., vol. 10, pp. 64–65, pl. 9, figs. 5a–c; Eocene, California.

Test small, subcircular to oval, dorsal side flat or slightly concave with raised papillate umbo, convex ventrally with small but definite umbilicus and usually a small plug visible; edge subacute except for portion of outer whorl which may be rounded; periphery entire except in last few chambers where it is slightly lobulate; chambers 9–12, evenly increasing in size, last few in larger specimens slightly inflated, distorted; tending to uncoil, sutures curved, limbate dorsally, later ones depressed; surface smooth, coarsely perforate; aperture a small arch at base of last septal face, with strong lip, extending dorsally between last two whorls for distance of 6 or 7 chambers. Diameter, 0.59 mm.; thickness, 0.20 mm.; very abundant.

This species differs from *Cibicides sassei* Cole (Bull. Am. Paleontology, vol. 14, 1927) mainly in lacking the ventral knob of shell material and in being plano-convex. From *C. praecursorius* (Schwager) (Palaeontographica, vol. 30, 1883) it differs in possessing a well defined papillate dorsal umbo. *C. mauricensis* Howe and Roberts (Louisiana Geol. Bull. 14, 1939) does not possess a ventral umbilicus and has an apertural overhang on the dorsal side. From *C. howelli* Toulmin (Cush. Lab. Foram. Res. Contr., vol. 15, pl. 82) it differs mainly in lacking the prominent ventral umbo.

Plesiotype, no. 4568.

CIBICIDES HOWELLI Toulmin
Plate 61, figures 9a–c

Cibicides howelli Toulmin, Jour. Paleontology, vol. 15, 1941, p. 609, pl. 82, figs. 16–18; Lower Eocene, Alabama.

Cibicides praecursorius (Cushman and Renz), Cushman Lab. Foram. Res. Contr., vol. 18, pt. 1, 1942, p. 13, pl. 3, figs. 9a–c; Eocene, Trinidad.

Not *Cibicides howelli*, Cushman and Renz, idem, fig. 10.

Test subcircular, flat or slightly concave dorsally with papillate boss obscuring all but last whorl; ventral side convex with prominent smooth translucent or finely granulate boss; edge of most of last whorl acute, limbate, edge of later portion bluntly angled; periphery smooth except on last few chambers where it is slightly lobulate; chambers 9–11, increasing regularly in size except last few which are commonly distorted and inflated; sutures curved, more so dorsally, limbate, early ones flush, later ones depressed on both sides; surface smooth, coarsely perforate; aperture a narrow opening extending from a short distance on ventral side, over periphery with lip and along suture between last two whorls for distance of 2 or 3 chambers. Diameter, 0.56 mm.; thickness, 0.31 mm.; common.

This form differs from *C. praecursorius* (Schwager) (Palaeontographica, vol. 30, 1883) mainly in possessing a marked dorsal boss obscuring the earlier whorls. From *C. sassei* Cole (Bull. Am. Paleontology, vol. 14, 1927) it differs in being planoconvex, with an acute edge, and the aperture extends for a distance of several chambers on the dorsal side.

Plesiotype, no. 4569.

CIBICIDES LOBATUS (d'Orbigny)
Plate 62, figures 1a–c

Truncatulina lobata d'Orbigny, 1839, in Barker, Webb and Berthelot, Hist. Nat. Iles Canaries, vol. 2, pt. 2, "Foraminiferes," p. 134, pl. 2, figs. 22–24; Recent, Canaries.

Truncatulina lobatula d'Orbigny, 1846, Foram. Foss. Vienna, p. 168, pl. 9, figs. 18–23; Middle Miocene, Vienna.

Cibicides lobatulus, Cushman, 1935, U. S. Geol. Survey Prof. Paper 181, p. 52, pl. 22, fig. 4 (not 5 and 6); Upper Eocene, southeastern U. S.—Cole and Gillespie, 1930, Bull. Am. Paleontology, vol. 15, no. 57B, p. 15, pl. 4, fig. 2; Middle Oligocene, Mexico.

Cibicides lobatus, Galloway and Wissler, 1927, Jour. Paleontology, vol. 1, pp. 64–65, pl. 11, fig. 1; Pleistocene, California.—Galloway and Heminway, 1941, New York Acad. Sci., Sci. Survey Porto Rico and the Virgin Islands, vol. 3, pt. 4, pp. 393–394, pl. 24, figs. 4a–c; Middle Oligocene, Upper Oligocene, and Lower Miocene, Porto Rico.

Test planoconvex, much compressed, dorsal side flat or concave, ventral side moderately convex; edge acute; periphery only slightly lobate; chambers regularly increasing in size, about 6 to 8 in last whorl; sutures curved, flush, limbate on dorsal side, on ven-

tral side depressed, only slightly curved; wall coarsely perforate; aperture at base of septal face on periphery with slight lip above, extending on dorsal side along suture line between last two whorls for distance of 2 or 3 chambers. Diameter of figured specimen, 0.61 by 0.94 mm.; thickness, 0.13 mm.; rare.

Plesiotype, no. 4570.

CIBICIDES MEXICANUS Nuttall
Plate 62, figures 2a–c

Cibicides mexicana Nuttall, 1932, Jour. Paleontology, vol. 6, p. 33, pl. 9, figs. 7–9; Eocene (?), Lower Oligocene, Mexico.—Hadley, 1934, Bull. Am. Paleontology, vol. 20, no. 70A, p. 28, pl. 4, figs. 7–8; Oligocene, Cuba.

Test subcircular in side view, planoconvex in edge view; dorsal side flattened except for low central convexity formed in part by early whorls and in part by secondary thickening of clear shell material; ventral side strongly convex with large low umbilical plug; edge sharply to broadly rounded; periphery nearly entire; chambers about 8 in last whorl enlarging gradually in size; only last whorl visible ventrally, with large umbilicus filled by plug of clear shell material; sutures gently curved, marked by clear shell material on both sides, slightly depressed both dorsally and ventrally; wall very coarsely perforate; aperture an elongate slit at base of septal face, extending from periphery three-fourths of way to umbilicus, and for short distance on dorsal side between last two chambers. Diameter, 0.76 mm.; thickness, 0.38 mm.; rare.

Plesiotype, no. 4571.

CIBICIDES PERLUCIDUS Nuttall
Plate 62, figures 3a–c

Cibicides perlucida Nuttall, 1932, Jour. Paleontology, vol. 6, p. 33, pl. 8, figs. 10–12; Lower Oligocene, Mexico, Eocene?

Cibicides perlucidus, Galloway and Heminway, 1941, New York Acad. Sci., Sci. Survey Porto Rico and Virgin Islands, vol. 3, pt. 4, pp. 394–395, pl. 23, figs. 4a–c; Upper Oligocene, Lower Miocene, Porto Rico.

Test subcircular in side view, dorsal side only slightly elevated, ventral side strongly convex with marked umbo of clear shell material; periphery entire; edge subacute; chambers 9–10 in last whorl enlarging gradually as added, slightly sunken to even or slightly inflated; whorls about 2½, early whorls partially obscured by slight, smooth, secondary thickening; spiral suture flush, bordered by thick band of clear shell material; dorsal sutures flush, more narrowly limbate; ventral sutures flush, bordered by thick bands of clear shell material which merge with central boss; wall with conspicuous medium sized perforations; aperture a low arch at base of last septal face near periphery, extending distance of less than one chamber along spiral suture on dorsal surface. Diameter, 0.47 mm.; thickness, 0.24 mm.; rare, mostly immature specimens occur.

This form differs from *C. tuxpamensis* Cole (Bull. Am. Paleontology, vol. 14, no. 53, 1928) in being smaller and having a rounded edge.

Plesiotype, no. 4572.

AMPHISTEGINA SIMIENSIS (Cushman and McMasters)
Plate 62, figures 4a–c

Asterigerina simiensis Cushman and McMasters, 1936, Jour. Paleontology, vol. 10, p. 515, pl. 77, figs. 1–4; Middle Eocene, California.

Test subcircular, evenly biconvex or strongly umbonate on one or both sides; edge acute to subacute; periphery carinate, entire excepting for slight lobulation of last half-whorl where carina is very narrow; chambers 15–16 in final whorl; sutures nearly radial, moderately raised on both sides; in ephebic specimens dorsal umbo covered with strong, raised knobs extending along sutures nearly to edge, ventral umbo and sutures with smaller knobs; knobs smaller or absent on neanic specimens; chamberlets of ventral rosette bounded by straight sutures, pointed outwardly, alternating regularly with ordinary chambers; wall conspicuously perforate with medium-sized pores; aperture a narrow slit at base of last septal face, wider peripherally with narrow lip; region around and especially posterior to aperture covered with fine papillae disposed in concentric lines; apertural face striated radially from aperture. Diameter up to 1.1 mm., averaging 0.8 mm. in diameter and 0.40 mm. in thickness. Very abundant.

Most Cape Blanco specimens are fairly well preserved and nearly all ontogenetic stages are represented. This species is very similar to *A. californica* Cushman and

Hanna (San Diego Soc. Nat. History Trans., vol. 5, 1927), but differs in being smaller with less prominent umbos, more evenly biconvex, not concave between umbo and periphery, and comparatively much thicker.

Plesiotype, no. 4563.

GLOBIGERINA EOCAENICA Terquem
Plate 62, figures 5a–c

Globigerina eocaenica Terquem, 1882, Soc. géol. France Mém., ser. 3, vol. 2, p. 86, pl. 9, fig. 4; Eocene, France.—Cole, 1928, Bull. Am. Paleontology, vol. 14, No. 53, p. 17, pl. 1, fig. 10; pl. 3, fig. 8; Upper Eocene, Chapapote, Mexico.—Cole and Gillespie, 1930, Bull. Am. Paleontology, vol. 15, no. 57B, p. 13, pl. 2, fig. 14; Oligocene, Meson fm., Mexico.

Test small, subglobular, slightly flattened, consisting of 3 chambers in last whorl; periphery broadly rounded, only slightly lobulate; chambers inflated, closely appressed, last chamber much larger than previous two; sutures slightly depressed; wall thick, reticulate, coarsely perforate; aperture a small low arched opening, with upper lip, located at base and entirely at one side of center of last chamber, length, 0.30 mm.; breadth, 0.25 mm.; thickness, 0.20 mm.; common.

Plesiotype, no. 4574.

GLOBIGERINA QUADRIPARTITA Koch
Plate 62, figures 6a–c

Globigerina bulloides quadripartita Koch, 1926, Eclogae geol. Helvetiae, Lausanne, Suisse, vol. 19, no. 3, p. 745, tf. 20a–c, X ca. 36; Middle Tertiary, Netherlands Indies.

Discorbis sp. Cushman and Todd, 1942, Cushman Lab. Foram. Res. Contr., vol. 18, pt. 2, p. 38, pl. 7, fig. 4; Eocene, Alabama.

Test small, globular, nearly equidimensional; periphery only slightly lobulate; dorsal side low, conical, with rounded spire, ventral side convex; whorls about 2½; chambers inflated, rather closely appressed, longer dorsoventrally than circumferentially or radially, gradually increasing in size, 4 in last whorl; sutures depressed, spiral suture deeper than sutures between chambers; ventral side with small, deep, central, quadrangular vestibule; wall coarsely perforate, thick; aperture an arch, with upper lip, opening into vestibule. Length, 0.27 mm.; breadth, 0.26 mm.; thickness, 0.23 mm.; common.

This form seems to agree well with Koch's species. Because of the lack of topotype material, however, there is some uncertainty as to its identification. This form also appears very similar to *G. conglomerata* Schwager, a globular species, but specimens assigned to the latter are mostly flattened. This species differs from *G. pachyderma* (Ehrenberg) in the higher spire and less closely appressed chambers.

Plesiotype, no. 4575.

GLOBIGERINA TRILOCULARIS d'Orbigny
Plate 62, figures 7a, b

Globigerina trilocularis d'Orbigny, 1826, Annals sci. nat., vol. 7, p. 277, no. 2; Miocene, near Bordeaux, France.—Galloway and Morrey, 1929, Bull. Am. Palaeontology, vol. 15, no. 55, p. 10, pl. 3, fig. 9; Lower Oligocene, Ecuador.—Galloway and Heminway, 1941, New York Acad. Sci., Sci. Survey Porto Rico and the Virgin Islands, vol. 3, pt. 4, p. 414, pl. 29, figs. 7a–b; Middle Oligocene to Lower Miocene, Porto Rico.

EXPLANATION OF PLATE 62

FIGS. *1*—*Cibicides lobatus* (d'Orbigny). ×60. *a*, Dorsal view; *b*, edge view; *c*, ventral view; plesiotype no. 4570. (p. 374)

2—*Cibicides mexicanus* Nuttall. ×30. *a*, Dorsal view; *b*, edge view; *c*, ventral view; plesiotype no. 4571. (p. 375)

3—*Cibicides perlucidus* Nuttall. ×60. *a*, Ventral view; *b*, edge view; *c*, dorsal view; plesiotype no. 4572. (p. 375)

4—*Amphistegina simiensis* (Cushman and McMasters). ×30. *a*, Dorsal view; *b*, edge view; *c*, ventral view; plesiotype no. 4563. (p. 375)

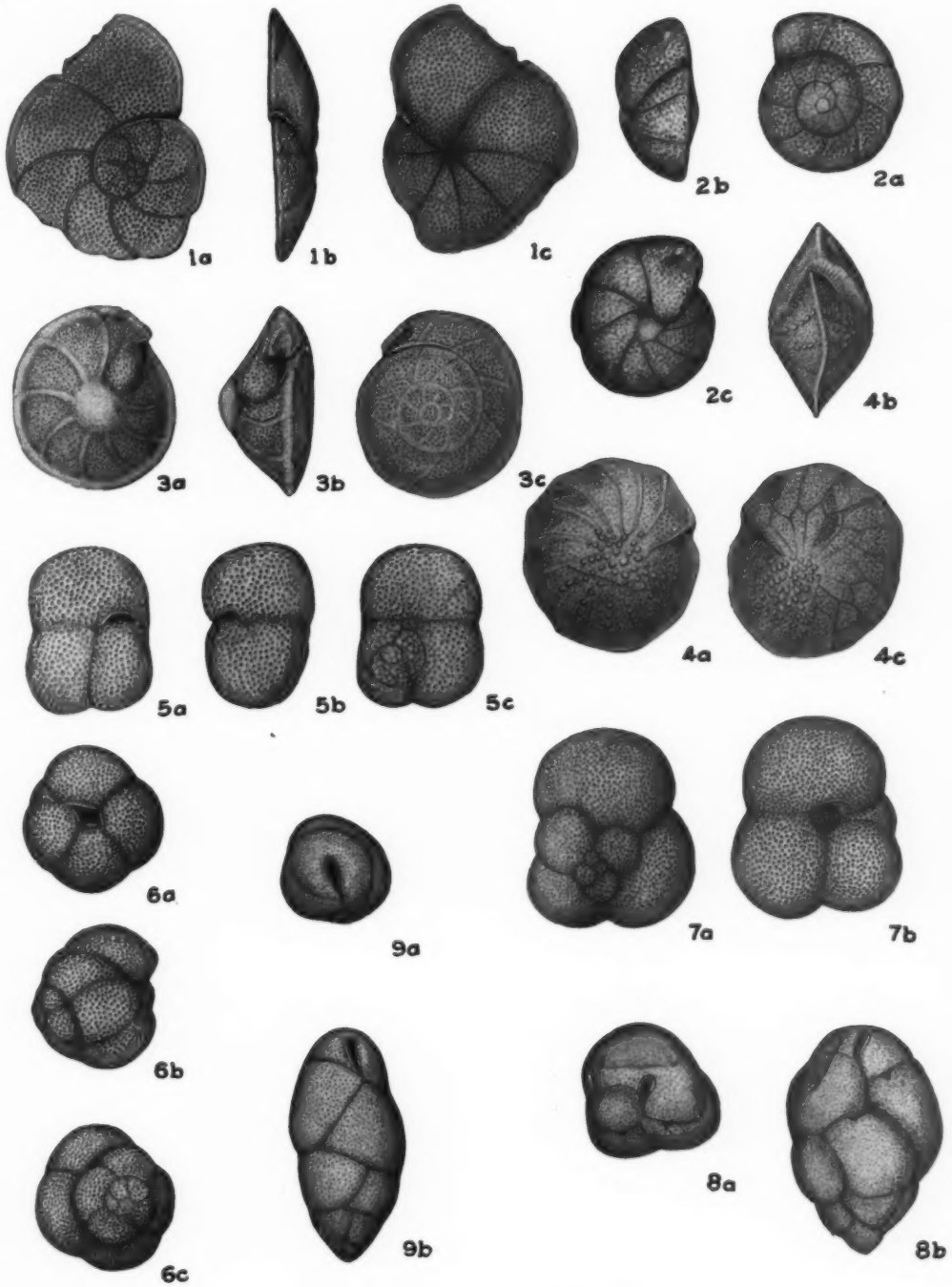
5—*Globigerina eocaenica* Terquem. ×80. *a*, Ventral view; *b*, edge view; *c*, dorsal view; plesiotype no. 4574. (p. 376)

6—*Globigerina quadripartita* Koch. ×80. *a*, Ventral view; *b*, edge view; *c*, dorsal view; plesiotype no. 4575. (p. 376)

7—*Globigerina trilocularis* d'Orbigny. ×80. *a*, Dorsal view; *b*, ventral view; plesiotype no. 4576. (p. 376)

8—*Bulimina ampla* Cushman and Parker. ×105. *a*, Apertural view; *b*, side view; plesiotype no. 4566. (p. 377)

9—*Bulimina pupoides* d'Orbigny. ×40. *a*, Apertural view; *b*, side view; plesiotype no. 4557. (p. 377)



Bandy—Eocene Foraminifera

UNIV. OF MICH.

Test subglobular, trochoid; of 8 or 9 globular chambers, 3 and a small portion of another in final whorl; last chamber forms one-third or more of entire test; wall coarsely perforate; aperture an arch at base of last chamber. Length, 0.36 mm.; breadth, 0.30 mm.; rare.

This form is very similar to *G. triloculinoides* Plummer (Texas Univ. Bull. 2644, 1926) but lacks the apertural flap of that species. Forms similar to this have been referred in *G. bulloides* d'Orbigny but differ in not possessing four full chambers in the final whorl.

Plesiotype, no. 4576.

BULIMINA AMPLA Cushman and Parker
Plate 62, figures 8a–b

Bulimina guayabalensis ampla Cushman and Parker, 1936, Cushman Lab. Foram. Res. Contr., vol. 12, p. 43, pl. 8, fig. 1; Eocene, California.

Test small, pyriform, greatest diameter near apertural end; chambers distinct, inflated; whorls about three; sutures depressed; surface smooth; aperture a small terminal virguline opening, without definite tooth. Length, 0.29 mm.; diameter, 0.19 mm.; rare.

The specimens are not well preserved but they seem to agree with Cushman and Parkers variety of Cole's species in all respects. The figured specimen is a young one which is slightly triangular in cross section; however, this shape changes so that older specimens are nearly circular in transverse section.

Plesiotype, no. 4566.

BULIMINA PUPOIDES d'Orbigny
Plate 62, figures 9a, b

Bulimina pupoides d'Orbigny, 1846, Foram. Foss. Vienne, p. 185, pl. 11, figs. 13, 14; Middle Miocene, Vienna.—Cushman, 1922, U. S. Geol. Survey Prof. Pap. 129-F, p. 127, pl. 29, fig. 7; Lower Oligocene, Mississippi.—Franke, 1927, Danmarks geol. Undersøgelse, Kjøbenhaven, raekke 2, Nr. 46, p. 11, pl. 1, fig. 8; Eocene, Denmark.—Cushman and Parker, 1937, Cushman Lab. Foram. Res. Contr., vol. 13, p. 47, pl. 6, figs. 2a–c (not fig. 3)—Parker and Bermudez, 1937, Jour. Paleontology, vol. 11, p. 515, pl. 59, figs. 4a–c, 5a–c not 3a–c; Eocene, Cuba.

Test elongate, about twice as long as wide, widest slightly above middle, moderately tapering to initial end; whorls about 4 or 5; chambers slightly inflated, increasing in size; sutures distinct, somewhat depressed; wall smooth, finely perforate; aperture virguline without tooth. Length, 0.81 mm.; diameter, 0.40 mm.; rare.

Plesiotype, no. 4567.

JOURNAL OF PALEONTOLOGY, VOL. 18, NO. 4, PP. 378–386, 1 TEXT FIG., JULY 1944

PENDENT GRAPTOLITES OF ARKANSAS, OKLAHOMA, AND TEXAS

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ABSTRACT—Pendent graptolites characteristic of the Lower Ordovician are widely distributed. In this region they occur in northeastern Arkansas, in the Arbuckle and Wichita Mountains of Oklahoma, in the Marathon region of Texas, and in the subsurface of deep wells in western Texas. In the Arbuckle Mountains there are five distinct zones, one above and four below the Simpson-Arbuckle contact. Nine species, one variety and one transient are included. Six of the species are new. Distribution and correlation of the known species are given and their associates noted.

INTRODUCTION AND ACKNOWLEDGMENTS

IN THE Arbuckle Mountains of Oklahoma pendent graptolites are significantly distributed in five distinct zones and most of the species are limited to a single zone as shown in table 1. Only one species, a variety, and a transient occur in more than one zone. The stratigraphic succession of known species tallies closely with the succession in Great Britain.

Grateful acknowledgement for assistance in the field is made to Rex McGehee, J. O. Beach, Brooks Pierce and William Hilseweck, and for supplying graptolites from cores of deep wells to the Phillips Petroleum Company, and the Gulf Oil Corporation.

EARLIER WORK

James Hall (14)[1] in 1865 named, illustrated, and described *Didymograptus bifidus* from the Quebec region in Canada. R. R. Gurley (13) in 1891 listed this species among the graptolites of North America. In 1903 Rudolf Ruedemann (21) described the same species from the Deepkill of eastern New York but the Deepkill forms, because of their association, seem to belong to a much lower zone than that of true *D. bifidus*. A lower zone in Great Britain carries *Didymograptus protobifidus* and associates similar to those in the Deepkill of New York and the Deepkill forms seem similar to *Didymograptus protogeminus* of Oklahoma.

Chester A. Reeds discovered *Didymograptus artus* Elles and Woods in the Arbuckle Mountains and E. O. Ulrich (22) in 1911 listed it from the Arbuckle limestone, but it is now known to occur in the Joins, the lowest formation in the Simpson group. In their monumental work on the Graptolites of Great Britain (1901–1918), Gertrude Elles (10) and Ethel M. Wood (Mrs. Shakespear) illustrated and described *D. artus* and *D. bifidus* from the Upper Arenig and noted their associates. In 1912 T. S. Hall (15) listed *D. bifidus* from near Chewton Station, Victoria. In 1932 Gertrude Elles (11) illustrated, and described *D. protobifidus* and worked out in great detail ten zones and subzones in the graptolite-bearing strata of Great Britain. In the graptolite succession of Bendigo East in Victoria William J. Harris (16) in 1934 established two graptolite zones in the *D. protobifidus* Passage Beds. In 1934 R. A. Keble and W. J. Harris listed this species from the Castlemaine Series in Connell's mine, 12 miles south of Doylesford, Victoria, Australia.

T. H. Clark (4) in 1935 illustrated *D. bifidus* from a hill south of Mount Pisgah near Logan, Utah. In the same year W. N. Benson (1) and R. A. Keble illustrated and described *D. protobifidus* from Cape Providence, New Zealand. Also, in 1935 the writer (5) illustrated and described *D. bifidus* from Black Rock Arkansas and *D. bifidus* and *D. artus* from the Arbuckle Mountains, Oklahoma and the latter from the core of a deep well in Oklahoma City.

In 1936 many articles appeared. W. N. Benson (2), R. A. Keble, L. C. King, and J. T. McKee listed *D. artus* and *D. protobifidus* in a table of the Lower Castlemanian graptolites of New Zealand. In this year

[1] See reference list at end of paper.

Gunnar Ekstrom (9) described and illustrated *D. bifidus* and many other pendent graptolites from the upper *Didymograptus* shale in Scania, southern Sweden. Astrid Monsen (19) described and illustrated the new variety *D. protobifidus praecursor* in a large graptolite fauna from the Lower Graptolite Beds of Norway. Also the writer (6, 7) in two articles on "Some Tentative Correlations on the Basis of Graptolites," discussed the significance, relative position, and wide distribution of the *D. protobifidus* zone and of the *D. bifidus-D. artus* zone.

Elisabeth A. Ripper (20) (Mrs. E. A. Holmes) in 1937 described and illustrated *D. protobifidus* from Victoria, Australia and compared these specimens in great detail with specimens from New Zealand and Great Britain. She likewise compared *D. bifidus* from Great Britain, New York and Canada. O. M. B. Bulman (3) in 1938, in a very comprehensive article on *Graptolithina*, described in detail the morphology of the Dendroidea and Graptoloidea, treated their development, physiology, and phylogeny, and described briefly each genus in both of these groups. R. A. Keble (18) and W. N. Benson in 1939 listed *D. bifidus* and *D. protobifidus* and showed their position in the lower Ordovician of Australia. In 1941 the writer (8) in an article on "*Didymograptus protobifidus* in North America" described and illustrated this species and numerous transients from Arkansas, Oklahoma, the Marathon Region of Texas, and from cores of deep wells in western Texas.

PENDENT GRAPTOLITES IN ARKANSAS, OKLAHOMA, TEXAS

Horizon: Species	1	2	3	4	5	6	7	8	9	10
Joins formation, Simpson group										
93′ *Didymograptus artus*	—	—	×	×	×	—	—	—	—	—
93′ *Didymograptus bifidus*	×	—	—	—	×	—	—	—	—	—
– – – – – Simpson-Arbuckle contact – – – – –										
West Spring Creek formation, Arbuckle group										
687′ *Didymograptus protogeminus* n. sp.	—	—	—	×	—	—	—	—	—	—
687′ *Didymograptus protomurchisoni* n. sp.	—	—	—	×	—	—	—	—	—	—
687′ *Didymograptus turneri* n. sp.	—	—	—	×	—	—	—	—	—	—
755′ *Didymograptus protobifidus*	—	—	—	×	—	—	—	—	—	—
755′ *Didymograptus protobifidus* transient	—	—	—	×	—	—	—	—	—	×
808′ *Didymograptus protobifidus*	—	—	—	×	—	—	—	—	—	—
808′ *Didymograptus protobifidus praecursor*	—	—	—	×	—	—	—	—	—	—
808′ *Didymograptus protobifidus* transient	—	—	—	×	—	—	—	—	—	—
845′ *Didymograptus protoartus* n. sp.	—	—	—	×	—	—	—	—	—	—
845′ *Didymograptus protobifidus*	—	×	—	×	—	×	—	×	×	—
845′ *Didymograptus protobifidus praecursor*	—	—	—	×	—	—	×	—	—	—
845′ *Didymograptus chapmani* n. sp.	—	—	—	×	—	—	—	—	—	—
845′ *Didymograptus bigcanyonsis* n. sp.	—	—	—	×	—	×	—	—	—	—

1, Black Rock, Ark.; 2, Smithville, Ark.; 3, Oklahoma City, Okla.; 4, Highway 77, Arbuckle Mountains; 5, Criner Hills, Okla.; 6, North Crusher Quarry; 7, Wichita Mountains; 8, Marathon, Texas; 9, Crane County, Texas; 10, Andrews County, Texas.

TABLE

In the following table the geographic distribution of species is shown by zones above and below the Simpson-Arbuckle contact, and the intervals, in feet, above and below this contact are indicated.

DESCRIPTION OF SPECIES

Genus DIDYMOGRAPTUS McCoy, 1851

DIDYMOGRAPTUS ARTUS Elles and Wood

Figures 26–28

Didymograptus artus Elles and Wood, 1901–1918, p. 48, pl. 4, figs. 6a–d.

Didymograptus artus Decker, 1935, p. 240, pl. 1, figs. 8, 9, 9a.

Original description—Stipes from 12 to 25 mm. in length, very narrow at their origin, but expanding throughout to a maximum of 1.3 mm.; diverging at a primary angle of about 90°, or with rounded base, and then curving gradually round so that the stipes are approximately parallel. Sicula small. Thecae very closely set, eighteen to nineteen in 10 mm., inclined at 50°, two or three times as long as wide, overlapping one-half to two-thirds their length. Apertural margin normal, concave, mucronate. . . . The species is allied to *D. bifidus*, but is smaller, and differs also in the parallel growth of the stipes, the greater uniformity in width, and in more closely set thecae.

Dimensions—The 3 colonies illustrated in figures 26, 27, 28 vary in length from 7 to 9 mm. but colonies sometimes attain a length of 15 or 16 mm.

Remarks—Typically the distance between the dorsal edges of the parallel stipes is 5 to 6 mm. but due to the extreme delicacy of the proximal parts of the stipes they frequently are found pressed more closely together and sometimes the distal ends are in contact, or less commonly the stipes may be found spread more widely than normal.

Occurrence—In the Arbuckle Mountains of Oklahoma the species occurs widespread in a narrow zone a few inches to a few feet thick in the lower part of the Joins, the basal formation of the Simpson group, and at the same horizon 6300 feet below the surface in the Oklahoma City field.

Associates—In the Arbuckle Mountains of Oklahoma it occurs with *D. bifidus* and in Great Britain other associates are *D. acutidens* and *D. nicholsoni*.

Types—Hypotypes; fig. 26, B2308; fig. 27; B2308a; fig. 28, A2049.

Explanation of Figures

Figures were drawn by the writer under a Parkes-Lapworth microscope magnified ×8 and now reduced to ×2. Drawings were inked by the writer and stippled by Anita C. Pick. All numbered types are in the Museum of Invertebrate Paleontology, University of Oklahoma. All magnifications are ×2.

Figs. *1, 11, 17—Didymograptus chapmani* n. sp.; *1, 11*, 845-foot zone Arbuckle Mountains, cotypes B2301, B2301a; *17*, north Crusher quarry near Big Canyon Station, Oklahoma. Cotype B2301b. (p. 385)

2, 3, 9, 10, 12—Didymograptus protobifidus praecursor Monsen, *2*, 845-foot zone Arbuckle Mountains, hypotype B2302; *3*, 808-foot zone Arbuckle Mountains, hypotype B2302a; *9*, 808-foot zone Arbuckle Mountains, hypotype A2001d; *10*, North side Wichita Mountains, Oklahoma, hypotype B2302b; *12*, from 845-foot zone Arbuckle Mountains, hypotype, B2302c. (p. 383)

4—Didymograptus protoartus n. sp., 845-foot zone, Arbuckle Mountains, holotype B2303. (p. 384)

5, 38, 39—Didymograptus protogeminus n. sp. *5*, 845-foot zone Arbuckle Mountains, cotype B2304; *38, 39*, 687-foot zone same locality, cotypes, B2304a, B2304b. (p. 384)

6, 8, 14, 19, 20, 21, 22, 24, 25—Didymograptus protobifidus Elles, *6, 8*, are from the 845 foot zone, Arbuckle Mountains, Oklahoma, hypotypes B2305, B2305a; *14* from Marathon Texas hypotype A2007; *19, 20* from 755 foot zone Arbuckle Mountains, hypotypes, B2305b, B2305c; *21* from well-core Crane county, Texas, hypotype, A2006; *22*, from Smithville, Arkansas, hypotype A2004; *24*, from 808-foot zone, Arbuckle Mountains, 25 from North Crusher quarry Arbuckle Mountains, hypotyptes B2305d, B2305e. (p. 382)

7, 13, 18—Didymograptus bigcanyonensis n. sp., *7*, 845-foot zone, Arbuckle Mountains, cotype B2306; *13, 18*, north Crusher quarry near Big Canyon Station, Oklahoma, cotypes B2306a, B2306b. (p. 385)

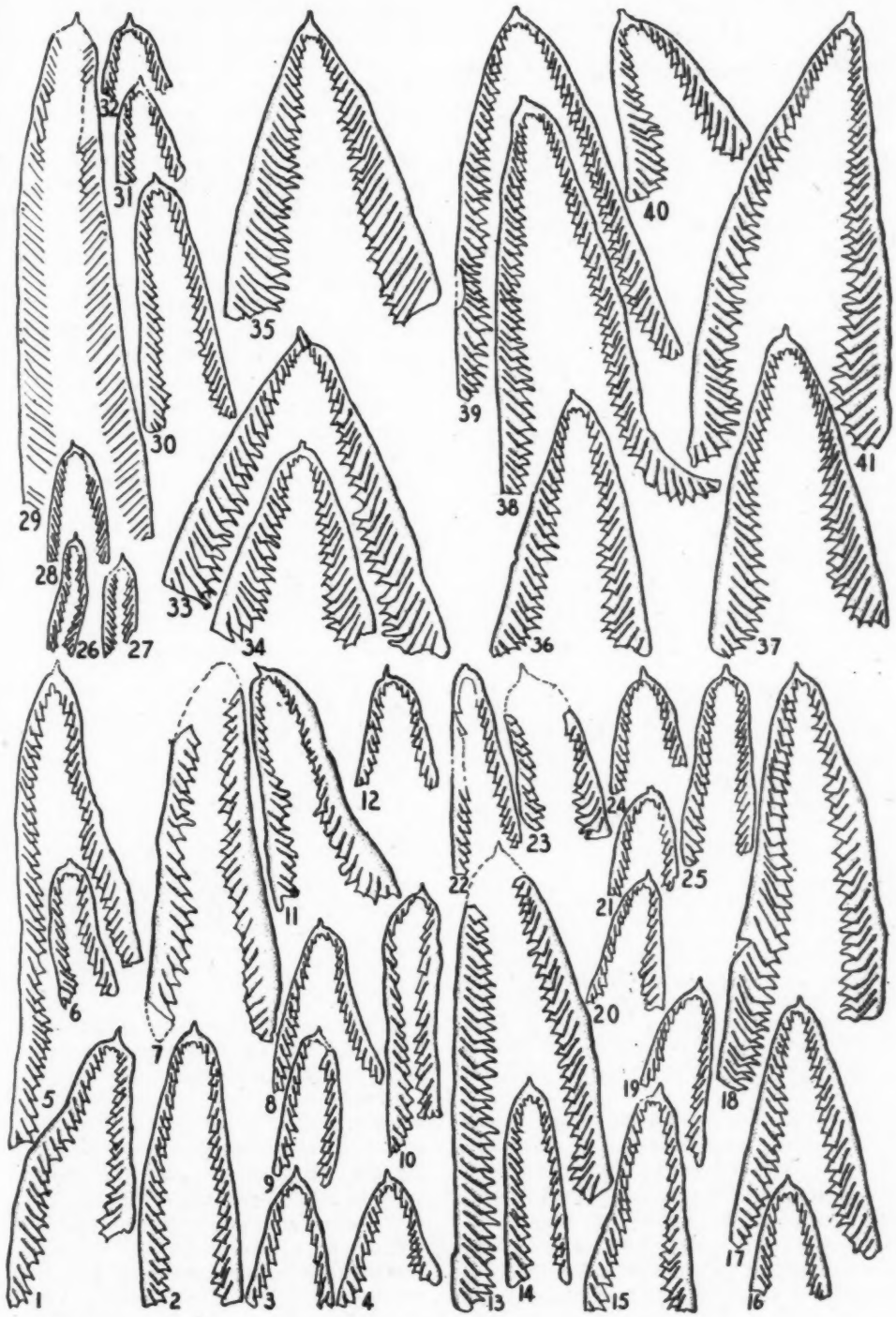
15, 16, 23—Didymograptus protobifidus transients, *15*, from 755-foot zone and *16*, from 808-foot zone; Arbuckle Mountains, nos. B2307, B2307a; *23*, from well-core Andrews Co., Texas, no. B2307b. (p. 383)

26–28—Didymograptus artus Elles and Wood; *26, 27* from Arbuckle Mountains, Oklahoma, hypotypes B2308, B2308a; *28* from well-core in Oklahoma City field, hypotype, A2049. (p. 379)

29–32—Didymograptus bifidus (Hall), *29, 30* from north end of Criner Hills, Oklahoma hypotypes B2309, B2309a; *31, 32* from Black Rock, Arkansas, hypotypes B2309b, 2309c. (p. 382)

33, 34, 35—Didymograptus protomurchisoni n. sp. all 687-foot zone, Arbuckle Mountains, cotypes B2310, B2310a, B2310b. (p. 384)

36, 37, 40, 41—Didymograptus turneri n. sp. all 687-foot zone Arbuckle Mountains, cotypes, B2311, B2311a, B2311b, B2311c. (p. 385)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FIGS. *1–41*

DIDYMOGRAPTUS BIFIDUS Hall
Figures 29–32

Graptolithus bifidus Hall, 1865, p. 73, pl. 1, 16–18; pl. 3, 9, 10.
Didymograptus bifidus Elles and Wood, 1901–1918, vols. 2 and 3, p. 42, text-figs. 26a, b and pl. 4, figs. 1a–f.
Didymograptus bifidus Ruedemann, 1903, p. 689, text-figs. 86, 87, pl. 15, figs. 1–3.

Elles and Wood give a synonymy of 5 references and Ruedemann gives one of 12 references.

Hall's original description follows:

Frond two-stiped: stipes diverging from the small short radicle, and curving slightly inward, and thence extending in right lines including an angle of from 15° to 20°, varied by growth or accident. Stipes very narrow, rounded at base, and gradually expanding above, attaining their greatest width at about two-thirds of the distance from the base, from which they are gradually narrowed to the extremity; they curve on the celluliferous margin, and are essentially straight on the back. The cellules continuing to increase in length as the stipe is extended to the point of greatest width, give the peculiar outline to the celluliferous margin. In the stipes of ordinary width, about one-sixth of the space is occupied by the common body; though this proportion varies with the development of the stipe. Test thin, nearly smooth, or with faint striae parallel to the cell-margins: divisions between the cellules strongly marked, and frequently terminating below in a minute pustule. The width of stipe varies from one-fifteenth of an inch at the base, to one-eighth, or even one-fourth of an inch, in the widest portions. Cellules long and slender, except a few at the base, and some partially developed near the apex: the length of the cellules is from three to four and a half times their width, according to the degree of development, and they incline to the axis at an angle of 48° near the lower part, curving more directly upwards in the middle, or more fully developed part of the stipe. Near the base of the stipe the angle of the cellules is greater, and toward the apex it is less until the last few are inclined at a very low angle. The cellules are free for from one-fourth to one-third of their length. The apex is extended in a submucronate point. The curving of the cell-margin forms an angle of about 120° with the axis in the widest part of the well-developed stipes.

Dimensions—The smaller forms vary in length from 6 to 17.5 mm. and one exceptionally large colony has a length of 36 mm. The greatest width of the smaller forms is 3 mm. and of the large form 3.5 mm.

Remarks—Hall significantly recognized the presence of a common canal which is characteristic of the hydrozoans. His description of the radicle or sicula at the base differs from the present method of orientation which places the sicula at the top.

Normally the forms associated with the Phyllograpti in the Deepkill of New York and described by Ruedemann as *D. bifidus*, should be *D. protobifidus* or transients of the latter. In Great Britain the *D. bifidus-D. artus* zone is considerably above the *D. protobifidus* zone and in Oklahoma the interval is between 800 and 900 feet.

Occurrence—*D. bifidus* occurs in the lower part of the Joins, the basal formation of the Simpson group, in the Arbuckle Mountains of south-central Oklahoma and in the Black Rock limestone near Black Rock in northeastern Arkansas. Described first from southern Canada it occurs commonly in Great Britain, Europe, Australia, and New Zealand.

Associates—The most common associate is *D. artus*.

Types—Hypotypes: fig. 29, B2309; fig. 30, B2309a; fig. 31, B2309b; fig. 32, B2309c.

DIDYMOGRAPTUS PROTOBIFIDUS Elles
Figures 6, 8, 14, 19–22, 24, 25

Didymograptus protobifidus Elles, 1933, p. 98, figs. 1, 2, 31.
Didymograptus protobifidus Ripper, 1936, p. 154, figs. 1a, b, c; 2a, b; 3; 8a, b, c, d.
Didymograptus protobifidus Decker, 1941, p. 362, pl. 52, figs. 2, 3, 4, 5, 9; pls. 53, figs. 1, 3, 4, 6, 7, 8, 9, 11, 12, 13.

Original Description—

Rhabdosome commonly small, stipes ranging from 1–2 cm. in length, narrow at origin, and increasing very slightly in width to a maximum of 1.3 mm., either running parallel or diverging in the manner of *D. bifidus*. Sicula conspicuous, slender. Thecae 13 in 10 mm., free ⅓ their length, inclined at a low but variable angle, slightly curved distally, with apertural margins slightly oblique to the general direction of the stipe.

Dimensions—The colonies range in length from 7.25 mm. to 14.5 mm. with most of them 9–12 mm. in length.

Remarks—Elles greatly enhanced the value of graptolites for correlation by differentiating this species and by distinguishing the graptolites of five zones and five subzones in the Skiddaw Slates. She also showed that graptolites grade from one species into another, in some forms through intermediate transients. Ripper has called attention to the development of *D. protobifidus* in Victoria, Australia and compared in detail its charac-

teristics with those of *D. bifidus*. The writer has noted the wide distribution of the former species and its transients in North America.

Occurrence—This species occurs in the Smithville limestone of northeastern Arkansas; about 800 feet below the top of the West Spring Creek, the uppermost formation of the Arbuckle group, in several localities in the Arbuckle Mountains of Oklahoma; in the Marathon limestone of southwest Texas; and at a depth of 6092–93 feet in a well in Crane county, western Texas.

Associates—In Oklahoma *D. protobifidus* is associated with *D. protobifidus praecursor*, *D. protobifidus* transients, *D. protoartus* n. sp., *D. chapmani* n. sp., *D. bigcanyonensis* n. sp., *Phyllograptus*, and fragments of Tetragrapti. In Great Britain it is associated with *D. nitidus*, *D. hirundo* transients, *D. patulus*, *D. extensus-D. nitidus* transients, *D nicholsoni*, *D. indentus*, *Isograptus*, several Phyllograpti, Tetragrapti, early Diplograpti and Glossograpti.

Types—Hypotypes: fig. 6, B2305; fig. 8, 2305a; fig. 14, A2007; fig. 19, B2305b; fig. 20, B2305c; fig. 21, A2006; fig. 22, A2004; fig. 24, B2305d; fig. 25, B235e.

DIDYMOGRAPTUS PROTOBIFIDUS transients

Figures 15, 16, 23

Description—The three specimens illustrated are small and exhibit characteristics intermediate between those of *D. protobifidus* and *D. bifidus*. Their increase in width is more like the latter but they have fewer thecae, about 13, in 10 mm.

Dimensions—The largest colony has a length of 19 mm. and the shortest one 9 mm. The proximal end of the one in the core from Andrews County, Texas, is exfoliated and very incomplete. Its distal ends are more than usually flattened.

Remarks—Gertrude Elles (11) recognized the importance of transient forms not only in the pendent graptolites but also in the extensiform Didymograpti.

Occurrence—These forms occur from 845 to 755 feet below the top of the Arbuckle limestone in the Arbuckle Mountains, Oklahoma.

Associates—It is associated with *Didymograptus protobifidus*, *D. protobifidus praecursor*, and *D. protoartus*.

Types—Specimen nos. B2307, B2307a, B2307b (figs. 15, 16, 23).

DIDYMOGRAPTUS PROTOBIFIDUS PRAECURSOR Monsen

Figures 2, 3, 9, 10, 12, 18, 34

Didymograptus protobifidus praecursor Monsen, 1937, p. 152, pl. 3, figs. 18, 34, table 9, fig. 10, table 10, figs. 13, 14, 15.

Description—

Diverging at an angle of 60° to 90° at the sicula, the stipes approach one another until they become parallel, or subparallel, or in some cases the distal ends touch. Stipes are 1.5 to 3 cm. long, proximal part being narrower than the distal. At the aperture the first thecae are .5 to .8 mm. wide and their width increases to a maximum width of 1.5 to 1.8 mm. generally not broader as a maximum than 1.3 to 1.5 mm. Thecae 8 proximally, 9 to 11 distally in 10 mm. Proximal thecae about 2 and distal 3 mm. long, more or less arched. Proximal thecae twice as long as wide, free ½ their length, distal about as long as wide and free ⅓ to ¼ their length. Proximal angle of inclination 20° to 25°, distal 30° to 35°.—Sicula 2.3 to 2.5 mm. long. The occurrence is in Stensberg Street, Galgeberg in the zone *Phyllograptus densus*, and *Phyllograptus augustifolius* var. *elongatus*, associated with *Didymograptus leptograptoides*, *D. nanus*, *D. minutus*, *D. extensus*, *Tetragraptus serra*. (Translation of description of main characteristics.)

Five different specimens of this variety are illustrated herewith. They conform well to the above description except that the stipes of two are more widely spread. The number of thecae is about at the upper limit of 11 in 10 mm. The shape of the thecae and the amount of overlap is about the same.

Dimensions—Stipes vary from a little less than 1 to 2 cm. in length. Proximally the width is .75 to 1 mm., in the middle of the stipe it is about 1.25 and distally where the stipes are widest, they may have a maximum width of 1.8 mm.

Remarks—It is significant that this Norwegian variety is well developed in both the Arbuckle and Wichita Mountains of Oklahoma. Its presence in the Wichita Mountains supplied evidence that the Upper Arbuckle, which had been thought to be absent there, is preserved in a syncline at the northwest edge of those mountains.

Occurrence—In Oklahoma this variety occurs about 3 miles north of Springer on the west side of U. S. Highway 77. It is most abundant in the zone 845 feet below the top

of the Arbuckle limestone, but a few specimens were found 37 feet higher in the main *D. protobifidus* zone. It occurs near the top of the outcrop in the syncline on the north side of the Wichita Mountains.

Associates—This variety occurs with *Phyllograptus anna*, *D. probifidus* and three new species, *D. protoartus*, *D. chapmani*, and *D. bigcanyonensis*.

Types—Hypotypes: fig. 2, B2302; fig. 3, B2302a; fig. 9, A2001d; fig. 10, B2302b; fig. 12, B2302c; fig. 18, B2302d; fig. 34, B2302e.

DIDYMOGRAPTUS PROTOARTUS Decker, n. sp.
Figure 4

Description—Colony small, stipes spread more widely than typical for *D. artus*, include an angle of 52° and retain direction throughout their length without bending together as is usual in *D. artus*. (This spreading may be abnormal.) Thecae 1.2 to 1.5 mm. long, 2 to 3 times as long as wide. Thecae 14 to 17 in 10 mm., inclined at an angle of 40° to 50°, overlapping ½ to ⅔ their length. Apertural margin, concave, mucronate about normal to direction of thecae. Length of sicula 1.1 mm.

Dimensions—The length of the colony is only a little over 10 mm., and distally the stipes spread to a width of 7 mm. The stipes vary in width from 0.75 to 1.4 mm.

Remarks—This species seems to be an earlier representative of the *D. artus* type except that the stipes spread more widely, while the thecae number 2 to 5 less in 10 mm.

Occurrence—It occurs on the west side of U. S. Highway 77 about 3 miles north of Springer 845 feet below the top of the Arbuckle limestone and nearly 1000 feet stratigraphically below the regular *D. artus-bifidus* zone.

Associates—It occurs with *D. protobifidus praecursor*, *D. chapmani* and *Phyllograptus anna*.

Types—Holotype no. B2303 (fig. 4).

DIDYMOGRAPTUS PROTOGEMINUS
Decker, n. sp.
Figures 5, 38, 39

Description—General shape similar to *D. geminus* but narrower, width increasing more gradually, thecae more overlapping. Thecae 13 to 14 in 10 mm. (about the average number for *D. geminus*), shorter, more mucronate when compressed, especially in left stipe. Apertural margin concave, normal to thecae. Overlap ⅔ to ¾, inclination 50° to 60°, stipes spreading gradually, curving out at distal ends where complete. One stipe curved out very distinctly. Sicular ends broken.

Dimensions—Stipes have lengths of 26, 30, and 32 mm. Distally, the colonies have a width of 110 to 130 mm. Thecae vary in length of 1 to 3 mm. Stipes are 1 to 2.5 mm. in width (.75 to 1 mm. narrower than those of *D. geminus*).

Remarks—This earlier species is very much like *D. geminus* in general form and appearance.

Occurrence—*D. murchisoni geminus* occurs in Great Britain above the *D. artus-D. bifidus* zone but in Oklahoma *D. protogeminus* occurs more than 700 feet below that zone, 687 feet below the top of the Arbuckle limestone.

Associates—*D. protogeminus* occurs with two other new species *D. protomurchisoni* and *D. turneri*.

Types—Cotypes: fig. 5, B2304; fig. 38, B2304a; fig. 39, B2304b.

DIDYMOGRAPTUS PROTOMURCHISONI
Decker, n. sp.
Figures 33–35

Description—Stipes incomplete but spreading more widely than in *D. murchisoni*, narrower proximally, increasing more rapidly to greater width at distal ends. Thecae 10 to 11 in 10 mm. (2 less than in *D. murchisoni*), angle of inclination 70° to 75° (greater, than in *D. murchisoni*). Apertural margin concave, mucronate, more so in left stipes which seems highly compressed. Overlap ⅔ or more (greater than in *D. murchisoni*).

Dimensions—The parts of colonies preserved have lengths of 14, 22.5, and 25 mm. Proximally the width of the stipes is about 0.6 and distally 4 mm. Thecae vary in length from 1 mm. proximally to 4 mm. distally.

Remarks—This earlier species differs from *D. murchisoni* in having fewer thecae in 10 mm., in being narrower proximally, by increasing more rapidly in width and in having a higher angle of inclination.

Occurrence—It occurs 687 feet below the top of the Arbuckle limestone in Oklahoma which is more than 700 feet below the *D. artus-D. bifidus* zone. In Great Britain *D. murchisoni* occurs above the *D. artus-D. bifidus* zone.

Associates—*D. protomurchisoni* is associated with two other new species in Oklahoma *D. protogeminus* and *D. turneri*.

Types—Cotypes: fig. 33, B2310; fig. 34, B2310a; fig. 35, B2310b.

DIDYMOGRAPTUS BIGCANYONENSIS Decker, n. sp. Figures 7, 13, 18

Description—Colonies relatively large; stipes broad, spreading slightly for entire length, increase in width mainly in proximal ½, two tapering at distal end. Thecae 11 in 10 mm., overlap ⅔ to ¾ of length. Thecal margin nearly straight to slightly concave, apertural margin varying from nearly normal to considerably inclined. Many thecae compressed, appear flat on surface, each exhibiting a mucral point.

Dimensions—The longest stipes have a length 26 to 30 mm. The width varies from 1 mm. proximally to 3 mm. distally. Thecae vary in length from 1.25 mm. to over 3 mm.

Remarks—This relatively large species is common in the lowest zone. Two of the specimens have the proximal ends exfoliated and none is quite complete.

Occurrence—*D. bigcanyonensis* occurs 845 feet below the top of the Arbuckle limestone on U. S. Highway 77, 3 miles north of Springer, and in the North Crusher quarry.

Associates—It is associated with *D. protobifidus*, the var. *praecursor*, and two other new species, *D. protoartus* and *D. chapmani*.

Types—Cotypes: fig. 7, B2306; fig. 13, B2306a; fig. 18, B2306b.

DIDYMOGRAPTUS CHAPMANI Decker, n. sp. Figures 1, 11, 17

Description—Colony relatively small, stipes spread slightly, tapering somewhat distally. Proximally 12 thecae in 10 mm., distally 11 in 10 mm. Overlap from ½ to ¾. Inclination about 70°. Apertural margin generally concave, commonly mucronate. Apertural margin slightly inclined.

Dimensions—Stipes vary from 17.5 to 20 mm. in length and from 0.9 to 2.75 mm. in width. Thecae vary in length from 1.25 to 2.25 mm.

Associates—This species is associated with *D. protobifidus*, the earlier variety *praecursor* and with two other new species *D. protoartus* and *D. bigcanyonensis*.

Types—Cotypes: fig. 1, B2301; fig. 11, B2301a; fig. 17, B2301b.

DIDYMOGRAPTUS TURNERI Decker, n. sp. Figures 36, 37, 40, 41

Description—Colonies small to moderate in size; stipes spreading gradually, one curved in more than others, narrow at proximal end, widening gradually most of distance toward distal end where they taper rapidly. Thecae 11 to 12 in 10 mm. Overlap ½ to ¾. Margin of thecal aperture concave, normal to slightly inclined to axis of thecae. Thecae from 2 to 4 times as long as wide, margin mucronate. Sicula on reverse side seems to be 1.5 mm. long.

Dimensions—Colonies are 13.75, 20, 22.5 and 32.5 mm. long and about 12 mm. wide distally. Stipes are .75 mm. wide proximally and attain a maximum of 4 mm. near the distal end. The thecae are 0.75 mm. long proximally, 4.25 mm. near distal end.

Remarks—These colonies of varying size are very similar in form, and are characterized by gradual widening of the stipes to a maximum width near the distal ends and then a sharp narrowing at the distal ends.

Occurrence—This new species has been found only at one locality, about 3 miles north of Springer, Oklahoma on the west side of U. S. Highway 77, 687 feet below the top of the Arbuckle limestone.

Associates—It occurs with two other new species, *D. protogeminus* and *D. protomurchisoni*.

Types—Cotypes: fig. 36, B2311; fig. 37, B2311a; fig. 40, B2311b; fig. 41, B2311c.

CONCLUSIONS

Didymograptus protobifidus occurs considerably below the *D. artus-D. bifidus* zone in Great Britain and about 900 feet below that zone in Oklahoma. It is of widespread occurrence in Australia, New Zealand, in the Smithville limestone of northeastern Arkansas, in the upper Arbuckle limestone at

several localities in Oklahoma, in the deep wells of Crane county, and in the Marathon region of Texas. *D. protobifidus praecursor*, described in Norway, occurs in the lower pendent graptolite zones of the Arbuckle Mountains of Oklahoma, and in similar beds preserved in a syncline on the north edge of the Wichita Mountains. The higher *D. artus-D. bifidus* zone of Great Britain occurs in the Scandinavian Peninsula, in Australia, and New Zealand and at numerous localities in the Joins, the lowest formation of the Simpson group of Oklahoma.

Not only has the Norwegian prototype of *D. protobifidus* been found in the lowest pendent graptolite zones in Oklahoma, but prototypes of three other earlier-known pendent graptolites have also been discovered there.

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BIBLIOGRAPHY AND INDEX TO NEW GENERA, SPECIES, AND VARIETIES OF FORAMINIFERA FOR THE YEAR 1941

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THE FOLLOWING bibliography comprises a total of 145 titles of publications devoted partly or exclusively to Foraminifera, of which 135 refer to the year 1941. One publication is added for 1932, 1938, and 1939 respectively, and 7 titles for the year 1940.

From the literature for the year 1941 there are recorded one new family, one new subfamily, 18 new genera, 297 new species, 45 new varieties (subspecies), one *forma nova*, 3 *nomina nova*, 10 homonyms, 3 synonyms, and 98 forms, to which the *nomenclatura aperta* has been applied.

Stratigraphically the new genera are distributed as follows: Permian 1, Jurassic 2, Cretaceous 1, Eocene 5, Oligocene 1, Miocene 3, Pliocene 1, and Pleistocene 2. One genus ranges from Miocene to Recent. They are allocated to the following families: one each to the Alveolinidae, Buliminidae, Fusulinidae, Hydromylinidae, Lagenidae, Nonionidae and Ophthalmidiidae; 2 each to the Miliolidae and Valvulinidae, and 4 to the Rotaliidae. No family relationships were given for three new genera.

Out of a total of 346 new forms of Foraminifera (species, varities, new names) 79% are from Cenozoic, 13% from Mesozoic and 8% from Paleozoic formations. The majority of new forms occurs in Tertiary beds (72%), the remainder in Cretaceous (12%), Paleozoic (8%), Pleistocene-Recent (7%), and Jurassic beds (1%).

Silurian accounts for 3%, Permian 5%, Liassic 1%, Cretaceous 12%, Eocene 18%, Oligocene 16%, Oligo-Miocene 16%, Miocene 15%, Mio-Pliocene 6%, Pliocene 1%, Plio-Pleistocene 1½%, Pleistocene 1½%, and Recent 4% of all the newly erected forms. No new forms have been recorded during 1941 from Cambrian, Devonian, Carboniferous, Middle and Upper Jurassic beds.

Several new species were described by Church (Bibliography *13*, p. 182), namely *Planularia markleyana*, *Plectofrondicularia jenkinsi*, *Pullenia lillisi*, and *Robulus welchi*, all from the Eocene of California. They are not listed in the following Index because they were cited as new species when their figures were published by Church in 1931.[1]

The new comprehensive monograph published by Marie (No. 77 of this Bibliography) was inaccessible, and it is regretted that the new forms erected by Marie could not be included in this index.

I wish to express my cordial thanks to Dr. J. A. Cushman, Miss Ruth Todd, Dr. H. G. Schenck, Dr. M. L. Thompson, Miss Irene Crespin, Mrs. Helen Jeanne Plummer, and Mrs. Heidi Thalmann for their kind coöperation in assembling the data for this bibliography and index.

Homonyms.—The following forms, erected during 1941, are regarded to be homonyms and, therefore, should be renamed by their respective authors:

Bolivina floridana Cushman, 1918, var. *regularis* Cushman and Renz, preoccupied by Nuttall, 1928.

Cibicides concavus Dorn in LeRoy, preoccupied by Tolmachoff, 1934.

Gaudryina (*Pseudogaudryina*) *jacksonensis* Cushman, 1926, var. *irregularis* Cushman and Renz, preoccupied by Hantken, 1876.

Lagena ampulla Galloway and Heminway, preoccupied by Buchner, 1940.

Lagennodosaria scalaris (Batsch, 1791) var. *hispida* LeRoy, preoccupied by d'Orbigny, 1846.

Nodosaria harrisi Vieaux, preoccupied by Cole, 1927.

Nodosaria insecta Schwager, 1866, var. *spinifera* LeRoy, preoccupied by Cushman and Campbell, 1935.

Quinqueloculina reticulata (d'Orbigny, 1826) var. *elongata* LeRoy, preoccupied by Karrer, 1877.

Textularia mississippiensis Cushman, 1922, var. *elongata* Davis, preoccupied by von Hagenow, 1842, by Cornuel, 1848, and by d'Orbigny, 1852.

Uvigerina compressa Palmer, 1941, preoccupied by Cushman, 1925. (Mrs. Palmer changed the name into *Uvigerina coartata* Palmer, 1941.)

[1] Jour. Paleontology, vol. 7, pp. 350–355, 1933.

Three *synonyms* were noted, namely *Angulogerina yumuriana* Palmer, which is regarded by Mrs. Palmer as being a synonym of *Angulogerina illingi* Cushman and Renz, 1941; *Antillesina* Galloway and Heminway, which is a synonym of *Cribropullenia* Thalmann, 1937, based on the same genotype; and *Siphogenerina yumuriana* Palmer, regarded by her as a synonym of *Siphogenerina senni* Cushman and Renz, 1941.

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113. TAPPAN, HELEN, New arenaceous Foraminifera from the Woodbine sand of northern Texas: Jour. Paleontology, vol. 15, pp. 359–361, pl. 51.

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GENERAL INDEX

(The numbers refer to the publications of the preceding Bibliography.)

General (Handbooks, biology, systematics, habitat, palecology, etc.): 3, 4, 6–8, 10, 19, 22, 28, 35, 40, 53, 68, 76, 81, 103, 105, 107, 108, 129, 139, 144.
Applied micropaleontology: 20, 21, 32, 50.
Bibliographies: 27, 114.
History: 20, 21, 53, 81.
Methods and Technique: 22, 32, 55, 70, 106, 143.
Necrology: 138, 142.

STRATIGRAPHIC INDEX

Cambrian: 135.
Silurian: 112.
Carboniferous: 1, 84, 87, 88, 99, 116.
Permian: 1, 40, 42, 54, 56, 57, 83, 87, 88, 94, 115, 117.
Liassic: 69a.
Jurassic: 60, 69.
Cretaceous: 11, 13, 15, 26, 30, 46, 52, 58, 59, 67, 73, 74, 76, 77, 95, 101, 102, 113, 119, 122–127, 130, 137, 140.
Tertiary: (general): 9, 52, 53, 100, 104, 109, 110, 123, 125, 133, 134, 141.
Eocene: 5, 8, 13, 14, 16, 36–39, 43, 44, 48, 51–53, 61, 72, 78, 82, 85, 98, 100, 120, 125, 139, 141.
Oligocene: 5, 17, 31, 37, 43, 45, 47, 49, 52, 53, 79, 89, 118, 121, 125, 128, 136, 141.
Miocene: 5, 17, 18, 25, 29, 31, 33, 37, 41, 45, 47, 49, 52, 53, 64, 65, 80, 92, 93, 97, 100, 111, 118, 125, 131–133, 141.
Pliocene: 17, 19, 24, 34, 52, 53, 63–66, 86, 131, 132.
Pleistocene: 7, 19, 24, 34, 66, 71, 75.
Recent: 2, 7, 12, 19, 22, 23, 25, 62, 90, 91, 96.
Brackish water habitat: 68, 80.

GEOGRAPHIC INDEX

(Countries are in alphabetical order)

AFRICA
Algeria, 34; *Egypt*, 36; *Somaliland*, 75.

AMERICA
Central America and *West Indies: Costa Rica*, 97; *Cuba*, 89, 114; *Haiti*, 33; *Jamaica*, 33; *Mexico*, 26, 83; *Panama*, 33; *Porto Rico*, 9, 47; *Santo Domingo*, 29.
North America: Alabama, 26, 48, 120; *Alaska*, 24; *Arkansas*, 26; *California*, 13, 33, 34, 41, 45, 49, 52, 61, 63, 78, 95, 118, 131–133; *Canada* (*and British Columbia*), 46, 117, 130; *Colorado*, 119; *Florida*, 16, 33, 111; *Gulf Coast*, 53, 72, 104; *Greenland*, 135; *Indiana*, 112; *Iowa*, 58; *Kansas*, 26; *Louisiana*, 5, 33, 68, 85; *Maryland*, 33; *Mississippi*, 26, 48, 80, 82; *Montana*, 46; *Nebraska*, 26; *Ohio*, 112; *Oklahoma*, 67; *Oregon*, 117; *Tennessee*, 26; *Texas*, 26, 37, 44, 67, 79, 113, 126; *Virginia*, 33; *Washington*, 1, 117; *Wyoming*, 46, 116.
South America: Antigua, 26, 121; *Colombia*, 14, 30; *Ecuador*, 33; *Trinidad* (*and Soldado Rock*), 26, 33, 51, 125; *Venezuela*, 31, 33.
ASIA
Afghanistan, 115; *British India*, 38, 39, 100, 101; *Burma*, 15, 43; *Japan*, 34, 56, 71, 86–88, 134; *Malay Peninsula*, 109; *Persia* (*Iran*), 102; *Syria*, 127; *Turkey*, 42, 122, 123; *U.S.S.R.* (*Asiatic*), 57.
EUROPE
Austria, 54; *Baltic States*, 84, 129; *Belgium*, 34; *Bulgaria*, 136; *England*, 69a; *France*, 25, 34, 73, 74, 76, 77, 137, 140; *Germany*, 4, 8, 84; *Greece*, 59; *Italy*, 34, 139; *Roumania*, 34; *Spain*, 34; *Switzerland*, 11, 60, 69, 124, 128; *Yugoslavia*, 98.
OCEANIA
Australia, 12, 17, 18, 91–94, 99, 101; *Borneo*, 64; *Fiji Islands*, 19, 34; *Java*, 2, 66; *Kei Islands*, 141; *Nicobar Islands* 34; *Philippine Islands*, 34; *Sumatra*, 65.
OCEANS
Adriatic, 25; *Atlantic*, 25, 90, 96; *Caribbean*, 22, 23, 35, 62; *Gulf of Oman*, 25; *Pacific*, 12, 91.

INDEX TO NEW GENERA, SPECIES, AND VARIETIES (SUBSPECIES) OF FORAMINIFERA FOR THE YEAR 1941[1]

ALABAMINA, gen. nov., Toulmin, **120,** p. 602, Fam. Rotaliidae. Genotype: *Alabamina wilcoxensis* Toulmin, 1941. Lower Eocene.

——— *wilcoxensis* Toulmin, **120,** p. 603, pl. 81, figs. 10–14; text figs. 4A–C. Lower Eocene, Alabama. [For: *Pulvinulinella exigua* (Brady, 1884) var. *obtusa* (Burrows and Holland, 1897) in Cushman and Ponton, 1932, Contr. Cushman Lab. Foram. Research, vol. 8, p. 71, pl. 9, fig. 9; for the same species in Jennings, 1936, Bull. Am. Paleontology, vol. 23, p. 192, pl. 31, fig. 4; for the same species in Howe, 1939, Louisiana Geol. Bull. no. 14, p. 81, pl. 9, figs. 4–6; and for: *Pulvinulinella obtusa* (Burrows and Holland, 1897) in Cushman and Garrett, 1939, Contr. Cushman Lab. Foram. Research, vol. 15, p. 87, pl. 15, figs. 12, 13.]

[1] The numbers in bold-face type following the author's name in the Index refer to the publications of the preceding Bibliography.

Ammobaculites lueckei Cushman and Hedberg, **30,** p. 83, pl. 21, fig. 4. Upper Cretaceous, Colombia, South America.

Ammodiscus nitidus Parr, **94,** p. 103, pl. 1, fig. 1. Permian, Western Australia.

——— *wandageensis* Parr, **94,** p. 102, pl. 2, fig. 1. Permian, Western Australia.

Amphicoryne obliqua Galloway and Heminway, **47,** p. 338, pl. 9, fig. 8. Oligo-Miocene, Puerto Rico.

Angulogerina cibaoensis Galloway and Heminway, **47,** p. 435, pl. 34, fig. 12. Upper Oligocene, Puerto Rico.

——— *cojimarensis* Palmer, **89,** p. 186, pl. 15, fig. 7. Upper Oligocene, Cuba.

——— *decorissima* Galloway and Heminway, **47,** p. 436, pl. 34, figs. 8–10. Lower Miocene, Puerto Rico.

——— *illingi* Cushman and Renz, **31,** p. 21, pl. 3, figs. 19, 20. Oligo-Miocene, Venezuela.

——— *liebusi* Puyt, **98,** p. 65, pl. 1, figs. 38–41. Paleocene, Hercegovina, Yugo-Slavia.

——— *ponceana* Galloway and Heminway, **47,** p. 437, pl. 34, fig. 11. Oligo-Miocene, Puerto Rico.

——— *yumuriana* Palmer, **89,** p. 186, pl. 15 fig. 8. Upper Oligocene. (Note: According to an appended note by Mrs. Palmer this species is synonymous with *Angulogerina illingi* Cushman and Renz, 1941.)

Anomalina pompilioides Galloway and Heminway, **47,** p. 389, pl. 22, fig. 3. Upper Oligocene, Puerto Rico. [For: *Anomalina grosserugosa* Cole, 1928 (non Gümbel, 1868), Bull. Am. Paleontology, vol. 14, no. 53, p. 18, pl. 1, figs. 16, 17; and for: *Anomalina grosserugosa* Nuttall, 1928, (non Gümbel, 1868), Quart. Jour. Geol. Soc. London, vol. 84, p. 99, pl. 7, fig. 18 (non fig. 19.]

ANTILLESINA, gen. nov., Galloway and Heminway, **47,** p. 366. Fam. Nonionidae Reuss, 1860, Genotype: *Nonion? marielensis* Palmer, 1936, Mem. Soc. Cubana Hist. Nat., vol. 10, p. 127, text figs. 1–3. Oligocene, (Note: As Thalmann has proposed in 1937 for the same genotype the new genus *Cribropullenia*, the new genus *Antillesina* becomes a synonym of *Cribropullenia*.)

Astacolus ovatus Galloway and Heminway, **47,** p. 334, pl. 8, fig. 10. Upper Oligocene, Puerto Rico.

Athecocyclina, see Pseudophragmina.

AUSTROTRILLINA, gen. nov., Parr, **92,** p. 361 (Published, March, 1942.) Fam. Miliolidae. Genotype: *Trillina howchini* Schlumberger, 1893, Bull. Soc. géol. France, (3), vol. 21, p. 119, pl. 3, fig. 6; text fig. 1. Miocene.

Baggina cojimarensis Palmer, **89,** p. 198. pl. 16, figs. 13, 14. Upper Oligocene, Cuba.

Bigenerina lytta Lalicker and Bermúdez,[62] p. 3, pl. 1, fig. 1. Recent, off Cuba, 160 fathoms.

——— *perna* Lalicker and Bermúdez, **62,** p. 4, pl. 1, figs. 3, 4. Recent, off Cuba, 210 fathoms.

Bolivina caudriae Cushman and Renz, **31,** p. 19, pl. 3, figs. 13, 14. Oligo-Miocene, Venezuela.

——— *floridana* Cushman, 1918, var. *regularis* Cushman and Renz, **31,** p. 17, pl. 3, fig. 17. Oligo-Miocene, Venezuela. (Note: The varietal name is preoccupied by *Bolivina regularis* Nuttall, 1928, Quart. Jour. Geol. Soc. London, vol. 84, p. 74, pl. 3, fig. 8.)

——— *heineae* Galloway and Heminway, **47,** p. 417, pl. 30, figs. 6, 7. Oligo-Miocene, Puerto Rico.

——— *inconspicua* Cushman and Renz, **31,** p. 18, pl. 3, figs. 10, 11. Basal Miocene, Venezuela.

——— *interjuncta* Cushman, 1926, var. *simplex* Cushman and Renz, **31,** p. 20, pl. 3, fig. 15. Oligo-Miocene, Venezuela.

——— *isidroensis* Cushman and Renz, **31,** p. 17, pl. 3, fig. 8. Miocene, Venezuela.

——— *matanzana* Palmer and Bermúdez, 1936, var. *convexa* Galloway and Heminway, **47,** p. 418, pl. 30, figs. 9, 10. Upper Oligocene, Puerto Rico.

——— *pozoensis* Cushman and Renz, **31,** p. 16, pl. 3, fig. 6. Miocene, Venezuela.

——— *rudderi* Cushman and Renz, **31,** p. 19, pl. 3, fig. 12. Miocene, Venezuela.

——— *suteri* Cushman and Renz, **31,** p. 18, pl. 3, fig. g. Miocene, Venezuela.

——— *ventricosa* Galloway and Heminway, **47,** p. 420, pl. 31, fig. 5. Oligo-Miocene, Puerto Rico.

Bolivinita quadrilatera (Schwager, 1866), var. *tortilis* Chapman, **12,** p. 169, pl. 3, (error for pl. 9), fig. 3. Recent, continental shelf, Australia.

Borelis gunteri Cole, **16,** p. 34, pl. 2, figs. 1–3; pl. 18, figs. 5, 6. Lower Eocene, Florida. [For: *Alveolina?* sp., Cushman, 1921, Florida Geol. Surv., 13th Annual Rept., p. 64, pl. 3, fig. 6.

——— ——— var. *floridana* Cole, **16,** p. 35, pl. 18, figs. 3, 4, 7, 8. Lower Eocene, Florida.

Bulimina laddi Cushman and Hedberg, **30,** p. 94, pl. 22, fig. 27. Upper Cretaceous, Colombia, South America.

——— *microlongistrista* LeRoy, **64,** p. 32, pl. 1, figs. 97, 98. Mio-Pliocene, East Borneo.

——— *notovata* Chapman, **12,** p. 166, not figured. Recent, continental shelf, Australia. [For: *Bulimina ovata* Brady, 1884, (non d'Orbigny, 1846), Rept. Voy. Challenger, Zool., vol. 9, pl. 50, figs. 13 a, b.]

——— *petroleana* Cushman and Hedberg, **30,** p. 95, pl. 22, fig. 31. Upper Cretaceous, Colombia, South America.

——— *simaensis* Makiyama and Nakagawa, **71,** p. 241, not figured. Pleistocene, Japan.

CARIXIA, gen. nov., Macfayden, **69a,** p. 27. Fam. Ophthalmidiidae. Genotype: *Carixia langi* Macfayden, 1941. Lower Liassic.

——— *langi* Macfayden, **69a,** p. 28, pl. 1, figs. 18–20. Lower Liassic, Dorset, England.

Carpenteria bulloides Galloway and Heminway, **47,** p. 404, pl. 27, figs. 1–4. Lower Miocene, Puerto Rico.

Cassidulina palmerae Bermudez and Acosta, 1940, var. *intermedia* Palmer, **89,** p. 282, pl. 28, fig. 2. Upper Oligocene, Cuba.

——— *subglobosa* Brady, 1881, var. *horizontalis* Cushman and Renz, **31,** p. 26, pl. 4, fig. 8. Oligo-Miocene, Venezuela.

——— *tricamerata* Galloway and Heminway, **47,** p. 425, pl. 32, fig. 3. Oligo-Miocene, Puerto Rico.

Cassidulinoides erecta Cushman and Renz, **31,** p. 25, pl. 4, figs. 6, 7. Miocene, Venezuela.

Chilostomella cushmani Chapman, **12,** p. 177, pl. 8, fig. 9; pl. 9, fig. 6. Recent, continental shelf, Australia. [For: *Chilostomella ovoidea* Cushman, 1919, (non Reuss, 1850), U. S. Nat. Mus. Proc., vol. 56, p. 621.]

——— *globata* Galloway and Heminway, **47,** p. 409, pl. 28, fig. 2. Oligo-Miocene, Puerto Rico.

——— *urceolus* Galloway and Heminway, **47,** p. 410, pl. 27, fig. 6. Oligo-Miocene, Puerto Rico.

Chrysalidinella? cubensis Palmer, **89,** p. 181, pl. 15, figs. 12, 13. Upper Oligocene, Cuba.

Cibicides bantamensis LeRoy, **66,** p. 119, pl. 2, figs. 10–12, 16–18. Plio-Pleistocene, Western Java.

——— *blanpiedi* Toulmin, **120,** p. 609, pl. 82, figs. 11–13. Lower Eocene, Alabama.

——— *concavus* Dorn in LeRoy, **64,** p. 47, pl. 2, figs. 82–84. Mio-Pliocene, East Borneo. (Species name preoccupied by Tolmachoff, 1934, Carnegie Mus. Ann., vol. 23, p. 339, pl. 42, figs. 22–24.)

——— *cryptomphalus* (Reuss, 1850), var. *herzegovinensis* Puyt, **98,** p. 70, pl. 1, figs. 59, 60; pl. 2, fig. 9. Paleocene, Hercegovina, Yugo-Slavia.

——— *floridanus* (Cushman, 1918), var. *compressa* Cushman and Renz, **31,** p. 26, pl. 4, fig. 9. Oligo-Miocene, Venezuela.

——— *hilgardi* Garrett, **48,** p. 155, pl. 26, figs. 13, 14. Middle Eocene, Alabama.

——— *howelli* Toulmin, **120,** p. 609, pl. 82, figs. 16–18. Lower Eocene, Alabama. [For: *Cibicides* cf. *pseudoungerianus* in Cushman and Garrett, 1939, Contr. Cushman Lab. Foram. Research, vol. 15, p. 88, pl. 15, figs. 25, 26.]

——— *isidroensis* Cushman and Renz, **31,** p. 26, pl. 4, fig. 10. Miocene, Venezuela.

——— *kugleri* Cushman and Renz, **31,** p. 27, pl. 4, fig. 11. Miocene, Venezuela.

——— *repettoensis* LeRoy, **63,** p. 622, pl. 84, figs. 1–4 (non figs. 1–12). Lower Pliocene, California.

——— *scalenus* Galloway and Heminway, **47,** p. 396, pl. 23, fig. 3. Upper Oligocene, Puerto Rico.

——— *soendaensis* LeRoy, **66,** p. 119, pl. 2, figs. 1–3. Plio-Pleistocene, western Java.

——— *spirolimbatus* Galloway and Heminway, **47,** p. 397, pl. 25, fig. 1. Lower Miocene, Puerto Rico. [Note: this species is from the Wilcox group, which is generally regarded as Lower Eocene.]

——— *williamsoni* Garrett, **48,** p. 156, pl. 26, fig. 15. Middle Eocene, Alabama.

CISALVEOLINA, gen. nov., Reichel, **102,** p. 255. Fam. Alveolinidae. Genotype: *Cisalveolina fallax* Reichel, 1941. Upper Cretaceous.

——— *fallax* Reichel, **102**, p. 257, pl. 15, figs. 1–3, text fig. 1. Cenomanian, Iran.
——— *lehneri* Reichel, **102**, p. 258, pl. 15, figs. 4–6. Cenomanian, Iran.
Clavulina carinata Cushman and Renz, **31**, p. 8, pl. 1, fig. 18. Oligo-Miocene, Venezuela.
Clavulinoides polygonalis Galloway and Heminway, **47**, p. 327, pl. 7, fig. 4. Lower Miocene, Puerto Rico.
——— *tricarinatus* LeRoy, **64**, p. 20, pl. 3, figs. 92, 93. Mio-Pliocene, East Borneo.
Codonofusiella nana Erk, **42**, p. 248, pl. 13, figs. 7–13. Permian, Turkey.
Coleites laevigatus Toulmin, **120**, p. 605, pl. 81, figs. 17–20. Lower Eocene, Alabama.
Coskinolina floridana Cole, **16**, p. 24, pl. 3, figs. 1–7; pl. 4, figs. 1–9; pl. 5, figs. 1–5, 11; pl. 18, fig. 9. Middle Eocene, Florida [For: *Coskinolina cookei* Moberg, 1928, Florida Geol. Surv., 19th Ann. Rept. p. 166, pl. 3, fig. 6 (non figs. 1–5, 7, 8).]
CRESPINELLA, gen. nov., Parr, **92**, p. 361. (Published March, 1942.) Fam. Rotaliidae. Genotype: *Operculina* (*?*) *umbonifera* Howchin and Parr, 1938, Trans. Roy. Soc. South Australia, vol. 62, pt. 2, p. 309, pl. 18, figs. 3, 4, 6, 13, 14. Miocene.
Cristellaria (*Robulus*) *umbonata* (Reuss, 1851), var. *dalmatina* Puyt, **98**, p. 49, pl. 1, figs. 43, 44. Paleocene, Hercegovina, Yugo-Slavia.
Crithionina teicherti Parr, **94**, p. 107, pl. 1, figs. 9, 10. Permian, Western Australia.
CUNEOLINELLA, gen. nov., Cushman and Bermúdez, **29**, p. 101. Fam. Valvulinidae. Genotype: *Cuneolinella lewisi* Cushman and Bermúdez, 1941. Miocene.
——— *lewisi* Cushman and Bermúdez, **29**, p. 102, pl. 24, figs. 1–3. Miocene, Dominican Republic.
——— ——— ——— ——— var. *intermedia* Cushman and Bermúdez, **29**, p. 102, pl. 24, figs. 4–6. Miocene, Dominican Republic.
Cycloclypeus victoriensis Crespin, **18**, p. 305, pl. 12, figs. 1–3, 5–8; pl. 13, figs. 9, 17; pl. 14, figs. 20–23; pl. 15, figs. 26–28, 31, 32. Middle Miocene, Batesfordian, Victoria, Australia. [For: *Cycloclypeus pustulous* Chapman, 1910 (non Chapman, 1905), Proc. Roy. Soc. Victoria, new series, vol. 22, p. 295, pl. 52, fig. 6; pl. 55, fig. 4; for: *Cycloclypeus communis* Chapman and Crespin, 1930 (non Martin, 1880), Proc. Roy. Soc. Victoria, new series, vol. 42, p. 112, pl. 7, figs. 7, 8; pl. 8, figs. 9–13; and for: *Cycloclypeus communis* Crespin 1936, (non Martin 1880), Pal. Bull., no. 2, Canberra, p. 7, pl. 1, figs. 10, 11.]
——— ——— ——— ——— var. *gippslandica* Crespin, **18**, p. 309, pl. 12, fig. 4; pl. 13, figs. 10–16, 18; pl. 14, figs, 19, 24, 25, 29, 30. Middle Miocene, Batesfordian, Victoria, Australia.
Cymbalopora dalmatina Puyt, **98**, p. 68, pl. 2, figs. 4, 33, 34. Paleocene, Hercegovina, Yugo-Slavia.

Dendritina prëelegans Galloway and Heminway, **47**, p. 315, pl. 5, fig. 5. Lower Miocene, Puerto Rico.
Dentalina halkyardi Cushman, 1933, var. *ponceana* Galloway and Heminway, **47**, p. 340, pl. 9, fig. 11. Oligo-Miocene, Puerto Rico.
——— *hillaeformis* Galloway and Heminway, **47**, p. 341, pl. 9, fig. 12. Oligo-Miocene, Puerto Rico. [For: *Nodosaria pauperata* Cushman, 1923 (non d'Orbigny, 1846), U. S. Nat. Mus. Bull. 104, pt. 4, pl. 14, fig. 13.]
——— *isidroensis* Cushman and Renz, **31**, p. 15, pl. 3, figs. 2, 3. Oligo-Miocene, Venezuela.
Dentalinopsis gigantea Vieaux, **126**, p. 626, pl. 85, fig. 7. Lower Cretaceous, Texas.
——— *quadrata* Vieaux, **126**, p. 626, pl. 85, fig. 8. Lower Cretaceous, Texas.
Discocyclina (*Discocyclina*) *barkeri* Vaughan and Cole, **125**, p. 57, pl. 18, figs. 4–7; pl. 21, figs. 1, 2. Paleocene,[2] Soldado Rock, Trinidad.
——— ——— *bullbrooki* Vaughan and Cole. **125**, p. 59, pl. 21, figs. 4, 5; pl. 22, figs. 1, 2. Upper Eocene, Soldado Rock, Trinidad.
——— ——— *grimsdalei* Vaughan and Cole, **125**, p. 58, pl. 18, figs. 8, 9; pl. 19, figs. 1–3; pl. 21, fig. 3. Paleocene,[2] Soldado Rock, Trinidad.
——— *strati-emanuelis* Brönnimann, **8**, p. 307, pl. 22, figs. 1–8; text figs. 2–4. Eocene, Bavaria, Germany.
Discorbis bodjongensis LeRoy, **66**, p. 116, pl. 1, figs. 9–11. Plio-Pleistocene, western Java.
——— *minima* Vieaux, **126**, p. 627, pl. 85, fig. 10. Lower Cretaceous, Texas.
——— *multisectus* Galloway and Heminway, **47**, p. 384, pl. 20, fig. 4. Middle Oligocene, Puerto Rico.
——— *oligospiratus* Galloway and Heminway, **47**, p. 384, pl. 21, fig. 1. Upper Oligocene, Puerto Rico. [For: *Discorbina globularis*, Flint, 1899 (non d'Orbigny, 1826), U. S. Nat. Mus., Ann. Rept. for 1897, 1899, p. 327, pl. 72, fig. 2.]
——— *pelliculatus* Galloway and Heminway, **47**, p. 385, pl. 21, fig. 6. Lower Miocene, Puerto Rico.
——— *washburni* Garrett, **48**, p. 155, pl. 26, fig. 10. Middle Eocene, Alabama. [Note: this species is from the Wilcox group, which is generally regarded as Lower Eocene.]
DISCORINOPSIS, gen. nov., Cole, **16**, p. 36. Fam. Rotaliidae. Genotype: *Discorinopsis gunteri* Cole, 1941. Middle Eocene.
——— *gunteri* Cole, **16**, p. 36, pl. 1, figs. 7–9. Middle Eocene, Florida.

Eggerella plummerae Toulmin, **120**, p. 572, pl. 78, figs. 6–8. Lower Eocene, Alabama.
EGGERINA, gen. nov., Toulmin, **120**, p. 573. Fam. Valvulinidae. Genotype: *Eggerina cyclindrica* Toulmin, 1941. Lower Eocene.
——— *cyclindrica* Toulmin, **120**, p. 573, pl. 78, figs. 9–11. Lower Eocene, Alabama.
Ehrenbergina bermúdezi Palmer, **89**, p. 283, pl. 28, fig. 1. Upper Oligocene, Cuba.

[2] Beginning with this bibliography and index, the Midway group and its stratigraphic equivalents is listed as Paleocene, whereas in previous lists it has been in part recorded as Lower Eocene.

——— *caribbea* Galloway and Heminway, **47,** p. 426, pl. 32, fig. 4. Oligo-Miocene, Puerto Rico. [For: *Ehrenbergina bradyi* Coryell and Rivero, 1940 (non Cushman, 1927), Jour. Paleontology, vol. 14, p. 342, pl. 44, fig. 22.]

——— *serrata* Reuss, 1850, var. *gibbera* Galloway and Heminway, **47,** p. 427, pl. 32, fig. 5. Oligo-Miocene, Puerto Rico.

Elphidiella nitida Cushman, **24,** p. 35, pl. 9, fig. 4. Plio-Pleistocene, Alaska. [For: *Elphidium hannai* Cushman and Grant, var., 1927, Trans. San Diego Soc. Nat. Hist., vol. 5, p. 78, pl. 8, fig. 2; for same species in Cushman, Stewart, and Stewart, 1930, ibid., vol. 6, p. 62, pl. 3, figs. 16, 17; for same species in Cushman, 1939, U. S. Geol. Surv. Prof. Pap. 191, p. 66, pl. 9, fig. 2 (non fig. 1); and for same species in Cushman and McCulloch, 1940, Allan Hancock Pacific Exped., vol. 6, no. 3, p. 177, pl. 20, fig. 11.]

Elphidium lens Galloway and Heminway, **47,** p. 361, pl. 14, fig. 10. Middle Oligocene, Puerto Rico.

——— *lobatum* Galloway and Heminway, **47,** p. 362, pl. 14, fig. 8. Upper Oligocene, Puerto Rico.

——— *nautiloideum* Galloway and Heminway, **47,** p. 362, pl. 14, fig. 5. Middle Oligocene, Puerto Rico.

——— *puertoricense* Galloway and Heminway, **47,** p. 364, pl. 15, fig. 2. Middle Oligocene, Puerto Rico.

——— *sagrai* (d'Orbigny, 1839) var. *crassum* Galloway and Heminway, **47,** p. 366, pl. 15, fig. 1. Middle Oligocene, Puerto Rico.

——— *simaense* Makiyama and Nakagawa, **71,** p. 241, text fig. 2. Pleistocene, Japan.

Epistomaria? cubana Palmer, **89,** p. 195, pl. 16, figs. 7, 11. Upper Oligocene, Cuba.

Epistomaria pontifera Galloway and Heminway, **47,** p. 386, pl. 24, fig. 2. Oligo-Miocene, Puerto Rico.

Epistomina charlottae Vieaux, **126,** p. 627, pl. 85, fig. 9. Lower Cretaceous, Texas.

Eponides byramensis (Cushman, 1922) var. *campester* Palmer and Bermúdez in Palmer, **89,** p. 192. Upper Oligocene, Cuba. [*Nomen novum* for: *Eponides byramensis* (Cushman, 1922) var. *cubensis* Palmer and Bermúdez, 1936, Mem. Soc. Cubana Hist. Nat., vol. 10, p. 302, pl. 20, figs. 4–6; *non Eponides cubensis* Palmer and Bermúdez, 1936, ibid., p. 252, pl. 21, figs. 10–12.]

——— *carolinensis* Cushman, 1935, var. *dalmatina* Puyt, **98,** p. 66, pl. 1, figs. 52, 57; pl. 2, fig. 2. Paleocene, Hercegovina, Yugo-Slavia.

——— *dorfi* Toulmin, **120,** p. 601, pl. 81, figs. 8, 9; text figs. 4-E. Lower Eocene, Alabama.

——— *lowei* Garrett, **48,** p. 155, pl. 26, fig. 12. Middle Eocene, Mississippi.

——— *mentaweiensis* LeRoy, **65,** p. 83, pl. 3, figs. 34–36. Mio-Pliocene, Siberoet Island, Sumatra.

——— *ornatissimus* Galloway and Heminway, **47,** p. 373, pl. 17, fig. 2. Middle Oligocene, Puerto Rico.

——— *parantillarum* Galloway and Heminway, **47,** p. 374, pl. 18, fig. 1. Lower Miocene, Puerto Rico. [For: *Eponides antillarum* Cushman and Jarvis, 1930, (non d'Orbigny, 1839) Jour. Paleontology, vol. 4, p. 364, pl. 33, fig. 14; pl. 34, fig. 2.]

——— *pulvinus* Galloway and Heminway, **47,** p. 375, pl. 18, fig. 2. Lower Miocene, Puerto Rico.

——— *punctatus* LeRoy, **64,** p. 39, pl. 1, figs. 46–48. Mio-Pliocene, East Borneo. (Note: *cave Eponides punctulata* (d'Orbigny, 1826, *Rotalia*).

——— *ventricosus* Galloway and Heminway, **47,** p. 376, pl. 18, fig. 3. Upper Oligocene, Puerto Rico.

——— *vortex* Galloway and Heminway, **47,** p. 376, pl. 18, fig. 4. Upper Oligocene, Puerto Rico.

Flabellammina brachylocula Tappan, **113,** p. 360, pl. 51, fig. 9. Upper Cretaceous, Texas.

——— *denisonensis* Tappan, **113,** p. 360, pl. 51, figs. 1–8. Upper Cretaceous, Texas.

Flabellinella delicata Loeblich and Tappan, **67,** p. 18, pl. 2, figs. 17–19. Lower Cretaceous, Texas.

——— *plana* Loeblich and Tappan, **67,** p. 19, pl. 2, figs. 13–15. Lower Cretaceous, Texas.

——— ——— var. *striata* Loeblich and Tappan, **67,** p. 21, pl. 2, fig. 16. Lower Cretaceous, Oklahoma.

Frondicularia cushmani Loeblich and Tappan, **67,** p. 14, pl. 3, fig. 4. Lower Cretaceous, Texas.

——— *hilli* Loeblich and Tappan, **67,** p. 15, pl. 3, figs. 2, 3. Lower Cretaceous, Texas.

——— *lalickeri* Vieaux, **126,** p. 626, pl. 85, fig. 6. Lower Cretaceous, Texas.

Gaudryina glabrata Cushman, 1937, var. *maxima* Galloway and Heminway, **47,** p. 323, pl. 7, fig. 2. Upper Oligocene, Puerto Rico.

——— *leuzingeri* Cushman and Renz, **31,** p. 6, pl. 1, fig. 13. Miocene, Venezuela.

——— *puertoricana* Galloway and Heminway, **47,** p. 324, pl. 7, fig. 7. Middle Oligocene, Puerto Rico.

——— *thalmanni* Cushman and Renz, **31,** p. 7, pl. 1, fig. 14. Basal Miocene, Venezuela.

——— (*Pseudogaudryina*) *jacksonensis* Cushman, 1926, var. *irregularis* Cushman and Renz, **31,** p. 6, pl. 1, figs. 11, 12. Upper Oligocene, Venezuela. (Note: the varietal name is preoccupied by *Gaudryina irregularis* Hantken, 1876, A magy. kir. földt. int. evkönyve, vol. 4, p. 12, pl. 1, fig. 7.)

GEMINOSPIRA gen. nov., Makiyama and Nakagawa, **71,** p. 241. Family not given. Genotype: *Geminospira simaensis* Makiyama and Nakagawa, 1941. Pleistocene.

——— *simaensis* Makiyama and Nakagawa, **71,** p.241, text figs. 3, 4. Pleistocene, Japan.

Globorotalia wilcoxensis Cushman and Ponton, 1932, var. *acuta* Toulmin, **120,** p. 608, pl. 82, figs. 6–8. Lower Eocene, Alabama.

Glomospira adhaerens Parr, **95,** p. 103, pl. 1, fig. 2. Permian, Western Australia.

Guttulina basalis Galloway and Heminway, **47,** p. 354, pl. 13, fig. 4. Lower Miocene, Puerto Rico.

Gyroidina depressa (Alth, 1850) var. *colombiana* Cushman and Hedberg, **30,** p. 97, pl. 23, fig. 13. Upper Cretaceous, Colombia, South America.

——— *lottensis* Garrett, **48,** p. 155, pl. 26, fig. 11. Middle Eocene, Alabama. [Note: this species is from the Wilcox group, which is generally regarded as Lower Eocene.]

——— *parva* Cushman and Renz, **31,** p. 23, pl. 4, fig. 2. Oligo-Miocene, Venezuela.

——— *planulata* Cushman and Renz, **31,** p. 23, pl. 4, fig. 1. Oligo-Miocene, Venezuela.

——— *stellifera* Galloway and Heminway, **47,** p. 378, pl. 15, fig. 8. Upper Oligocene, Puerto Rico.

Haplophragmoides carinatum Cushman and Renz, **31,** p. 2, pl. 1, fig. 1. Miocene, Venezuela.

——— *flagleri* Cushman and Hedberg, **30,** p. 82, pl. 21, fig. 2. Upper Cretaceous, Colombia, South America.

Hauerina sansebastianensis Galloway and Heminway, **47,** p. 315, pl. 5, figs. 3, 4. Middle Oligocene, Puerto Rico.

Helicostegina soldadensis Grimsdale, **51,** p. 86, pl. 46, figs. 1–7. Upper Eocene, Soldado Rock, Trinidad.

Hemicristellaria brantlyi Garrett, **48,** p. 154, pl. 26, figs. 1–4. Middle Eocene, Alabama. [Note: this species is from the Wilcox group, which is generally regarded as Lower Eocene.]

——— *hatchetigbeensis* Garrett, **48,** p. 154, pl. 26, figs. 5–7. Middle Eocene, Alabama.

——— ——— ——— var. *harrisi* Garrett, **48,** p. 155, pl. 26, figs. 8, 9. Middle Eocene, Alabama.

HYDROMYLINA, gen. nov., Puyt, **98,** p. 54. Fam. Hydromylinidae Puyt, 1941. Genotype: *Hydromylina rutteni* Puyt, 1941. Paleocene.

——— *rutteni* Puyt, **98,** p. 54, pl. 3, figs. 1–20. Paleocene, Hercegovina, Yugo-Slavia.

HYDROMYLINIDAE, fam. nov., Puyt, **98,** p. 54. Includes the genus *Hydromylina* Puyt, 1941 Paleocene.

Hyperammina coleyi Parr, **94,** p. 104, pl. 2, fig. 2. Permian, Western Australia.

———(?) *rudis* Parr, **94,** p. 105, pl. 1, fig. 3. Permian, Western Australia.

Hyperamminoides acicula Parr. **94,** p. 105, pl. 1, figs. 4, 5; pl. 2, fig. 4. Permian, Western Australia.

Lagena ampulla Galloway and Heminway, **47,** p. 345, pl. 11, fig. 9. Middle Oligocene, Puerto Rico. [For: *Ovulina tenuis* Bornemann, 1855, Zeitschr, deutsche geol. Ges., vol. 7, p. 317, pl. 12, fig. 3*a, b (non fig. 3a, b).] (Note: The species name is preoccupied by Buchner, 1940, Nova Acta Leopoldina, new series, vol. 9, no. 62.)

——— *bullosa* Galloway and Heminway, **47,** p. 345, pl. 11, fig. 10. Oligo-Miocene, Puerto Rico.

——— *cotaspiralata* LeRoy, **65,** p. 77, pl. 5, fig. 29. Mio-Pliocene, Siberoet Island, western Sumatra. (Note: The spelling of the species name on the explanation of pl. 5 is: *costa-spiralata.*)

——— *davoei* Macfayden, **69a,** p. 63, pl. 4, fig. 63. Lower Liassic. Dorset, England.

——— *impressa* Galloway and Heminway, **47,** p. 346, pl. 10, fig. 10. Oligo-Miocene, Puerto Rico.

——— *nuttalli* Galloway and Heminway, **47,** p. 346, pl. 10, fig. 8. Oligo-Miocene, Puerto Rico. [For: *Lagena sulcata* Nuttall, 1928, (non Walker and Jacob, 1798), Quart. Jour. Geol. Soc. London, vol. 84, p. 79, pl. 4, fig. 3.]

Lagennodosaria scalaris (Batsch, 1791) var. *hispida* LeRoy, **65,** p. 77, pl. 1, fig. 26. Mio-Pliocene, Siberoet Island, western Sumatra [(Note: The varietal name is preoccupied by *Lagennodosaria hispida* (d'Orbigny, 1846) according to Silvestri, 1900.)]

——— ——— ——— var. *seminuda* Chapman, **12,** p. 161, pl. 9, fig. 2. Recent, continental shelf, Australia.

Lamarckina echinata Galloway and Heminway, **47,** p. 368, pl. 15, fig. 5. Oligo-Miocene, Puerto Rico.

Lepidocyclina (*Pliolepidina*) *pustulosa* (H. Douvillé, 1917) forma *tobleri* (H. Douvillé, 1917) forma *teratologica* Vaughan and Cole, **125,** p. 66, pl. 24, figs. 1–10. Upper Eocene, Trinidad.

——— (*Nephrolepidina*) *sanfernandensis* Vaughan and Cole, **125,** p. 73, pl. 42, figs. 1–6; pl. 43, figs. 1–3; pl. 44, fig. 1. Upper Eocene, Trinidad.

Lepidorbitoides blanfordi Rao, **101,** p. 64, pl. 6, figs. 5–8, 10. Maestrichtian, southern British India. [For: *Orbitoides faujasi* Stoliczka, 1873, (non Defrance, 1823), Pal. Indica, vol. 4, p. 61, pl. 12, figs. 3–5.]

——— *inornata* Rao, **101,** p. 63, pl. 6, figs. 1, 3, 9 (non fig. 2). Maestrichtian, South British India.

Liebusella pozonensis Cushman and Renz, **31,** p. 9, pl. 2, figs. 1, 2. Oligo-Miocene, Venezuela.

——— ——— var. *crassa* Cushman and Renz, **31,** p. 16, pl. 2, figs. 3, 4. Miocene, Venezuela.

Lingulina grimsdalei Cushman and Renz, **31,** p. 14, pl. 3, fig. 1. Upper Oligocene, Venezuela.

——— *ponceana* Galloway and Heminway, **47,** p. 352, pl. 11, fig. 11. Oligo-Miocene, Puerto Rico.

——— *semicostata* Galloway and Heminway, **47,** p. 353, pl. 10, fig. 11. Oligo-Miocene, Puerto Rico.

——— *terquemi* Macfadyen, **69a,** p. 53, pl. 3, fig. 54. Lower Liassic, Dorset, England. [*Nomen novum* for: *Frondicularia rhomboidalis* Terquem, 1862 (non d'Orbigny, 1826), Mém. Acad. Imp. Metz, vol. 42, p. 439, pl. 5, fig. 19.]

Lituonella floridana Cole, **16,** p. 23, pl. 3, figs. 14–17; pl. 4, fig. 10; pl. 6, figs. 9–11. Eocene, Florida. [For: *Lituonella* sp.? Cushman, 1937, Cushman Lab. Foram. Research, Spec. Publ. 8, p. 185, pl. 22, fig. 14.]

Loxostoma etigoense Oinomikado, **86,** p. 86, text fig. 1. Pliocene, Japan.

Loxostomum normale Galloway and Heminway, **47,** p. 421, pl. 31, fig. 4. Upper Oligocene, Puerto Rico.

Marginulina basispinosa Cushman and Renz, **31,** p. 13, pl. 2, figs. 16–18. Middle Miocene, Venezuela.

——— *cyprina* Vieaux, **126,** p. 625, pl. 85, fig. 3. Lower Cretaceous, Texas.

——— *insulensis* Galloway and Heminway, **47,** p. 337, pl. 9, fig. 1. Oligo-Miocene, Puerto Rico.

——— *superba* Cushman and Renz, **31,** p. 14, pl. 2, figs. 19, 20. Middle Miocene, Venezuela.

Marginulinopsis wilcoxensis Toulmin, **120,** p. 582, pl. 79, figs. 4–6. Lower Eocene, Alabama.

Marsipella? torta Stewart and Priddy, **112,** p. 370, pl. 54, fig. 4. Silurian, Indiana.

Miscellanea soldadensis Vaughan and Cole, **125,** p. 36, pl. 4, figs. 8, 9. Paleocene, Soldado Rock, Trinidad.

——— *tobleri* Vaughan and Cole, **125,** p. 35, pl. 4, figs. 5–7; pl. 7, fig. 1. Eocene, Trinidad.

Neoschwagerina cascadensis Anderson, **1,** p. 190, pl. 1, figs. 1, 2; pl. 2, fig. 1. Permo-Carboniferous, Washington, U.S.A.

Nephrolepidina, see Lepidocyclina.

Nodosarella constricta Cushman and Bermúdez, 1937, var. *granulifera* Galloway and Heminway, **47,** p. 439, pl. 35, fig. 5. Oligo-Miocene, Puerto Rico.

Nodosaria barkeri Vieaux, **126,** p. 626, pl. 85, fig. 5. Lower Cretaceous, Texas.

——— *harrisi* Vieaux, **126,** p. 625, pl. 85, fig. 4. Lower Cretaceous, Texas. (Note: this species name is preoccupied by Cole, 1927, Bull. Am. Paleontology, vol. 14, no. 51, p. 16, pl. 3, fig. 2.)

——— *insecta* Schwager, 1866, var. *spinifera* LeRoy, **65,** p. 74, pl. 1, fig. 17. Mio-Pliocene, Siberoet Island, Western Sumatra. (Note: The varietal name is preoccupied by *Nodosaria spinifera* Cushman and Campbell, 1935, Contr. Cushman Lab. Froam. Research, vol. 11, p. 71, pl. 10, figs. 9, 10.)

——— *stainforthi* Cushman and Renz, **31,** p. 15, pl. 3, fig. 4. Oligo-Miocene, Venezuela.

Nonion dilatatum Galloway and Heminway, **47,** p. 356, pl. 13, fig. 6. Upper Oligocene, Puerto Rico.

——— *multiporatum* Galloway and Heminway, **47,** p. 356, pl. 13, fig. 7. Upper Oligocene, Puerto Rico.

——— *subgrateloupi* Galloway and Heminway, **47,** p. 358, pl. 14, figs. 2, 3. Lower Miocene, Puerto Rico.

Nonionella modesta Galloway and Heminway, **47,** p. 359, pl. 13, fig. 5. Middle Oligocene, Puerto Rico.

Notorotalia decurrens Chapman, **12,** p. 174, pl. 8, fig. 7. Recent, continental shelf, Australia.

OOLITELLA, gen. nov., Makiyama and Nakagawa, **71,** p. 242. Family not given. Genotype: *Oolitella irregularis* Makiyama and Nakagawa, 1941. Pleistocene.

——— *irregularis* Makiyama and Nakagawa, **71,** p. 242, text fig. 6. Pleistocene, Japan.

Operculinella sinuata Galloway and Heminway, **47,** p. 442, pl. 36, fig. 4. Lower Miocene, Puerto Rico.

Operculinoides bullbrooki Vaughan and Cole, **125,** p. 44, pl. 11, figs. 6, 7; pl. 12, figs. 4, 5. Oligocene, Trinidad.

——— *kugleri* Vaughan and Cole, **125,** p. 42, pl. 10, figs. 3–5, 7, 8; pl. 13, figs. 1, 2, 3? Upper Eocene, Soldado Rock, Trinidad.

——— *semmesi* Vaughan and Cole, 1936, var. *ciperensis* Vaughan and Cole, **125,** p. 51, pl. 15, figs. 3–8. Oligocene, Trinidad.

——— *soldanensis* Vaughan and Cole, **125,** p. 40, pl. 9, figs. 5–8; pl. 10, figs. 1, 2. Upper Eocene, Soldado Rock, Trinidad.

——— *tamaensis* Vaughan and Cole, **125,** p. 43, pl. 10, figs. 9, 10; pl. 11, figs. 8–10; pl. 12, figs. 1–3. Lower Miocene, Trinidad.

Orbitocyclina ariyalurensis Rao, **101,** p. 62, pl. 6, fig. 2 (non fig. 1.) Maestrichtian, Southern India.

Orbulina universa d'Orbigny, 1839, var. *bisphaerica* LeRoy, **64,** p. 44, pl. 1, fig. 3. Mio-Pliocene, East Borneo.

Palmula acuta Loeblich and Tappan, **67,** p. 7, pl. 1, figs. 3, 4. Lower Cretaceous, Texas.

——— *decorata* Loeblich and Tappan, **67,** p. 8, pl. 1, fig. 5. Lower Cretaceous, Texas.

——— *dentonensis* Loeblich and Tappan, **67,** p. 9, pl. 2, fig. 1. Lower Cretaceous, Texas.

——— *howei* Loeblich and Tappan, **67,** p. 9, pl. 2, figs. 4–7. Lower Cretaceous, Texas.

——— *leai* Loeblich and Tappan, **67,** p. 10, pl. 1, figs. 1, 2. Lower Cretaceous, Texas.

——— *leptata* Loeblich and Tappan, **67,** p. 11, pl. 2, fig. 2. Lower Cretaceous, Texas.

——— *limbata* Loeblich and Tappan, **67,** p. 12, pl. 1, figs. 6–10. Lower Cretaceous, Texas.

——— *lozoi* Loeblich and Tappan, **67,** p. 13, pl. 2, fig. 3. Lower Cretaceous, Texas.

——— *mcglameryae* Toulmin, **120,** p. 592, pl. 80, figs. 1–3. Lower Eocene, Alabama.

——— *tarrantensis* Loeblich and Tappan, **67,** p. 13, pl. 2, figs. 8–12. Lower Cretaceous, Texas.

Parafrondicularia helenae Chapman, **12,** p. 170, pl. 9, fig. 5. Recent, continental shelf, Australia. [For: *Frondicularia interrupta* Brady, 1884 (non Karrer, 1877), Challenger Exped., Zool., vol. 9, p. 523, pl. 66, figs. 6, 7.]

Parrella expansa Toulmin, **120,** p. 604, text figs. 3, 4-F, 4-G. Lower Eocene, Alabama. [For: *Truncatulina culter* (Parker and Jones) in Plummer, 1927, Univ. Texas Bull. 2644, p. 147, pl. 10, fig. 1; pl. 15, fig. 2; and for: *Pulvinulinella culter* (Parker and Jones) var. *mexicana* in Cushman, 1940, Contr. Cushman Lab. Foram. Research, vol. 16, p. 72, pl. 12, fig. 12.]

Pellatispira inflata Umbgrove, 1928, var. *minor* Rao, **100,** p. 15, pl. 1, figs. 3, 7. Lower Priabonian, Tarkeshwar, western British India.

——— *madaraszi* (Hantken, 1875) var. *indica* Rao, **100,** p. 13, pl. 1, figs. 2, 5; pl. 2, fig. 3. Lower Priabonian, Tarkeshwar, western British India.

Planorbulinella larvata (Parker and Jones, 1860) var. *cojimarensis* Palmer, **89,** p. 298, pl. 31, fig. 3. Upper Oligocene, Cuba.

Planularia arbenzi Cushman and Renz, **31,** p. 13, pl. 2, fig. 13. Oligo-Miocene, Venezuela.

——— *australis* Chapman, **12,** p. 158, pl. 9, fig. 1. Recent, continental shelf, Australia. [For: *Cristellaria tricarinella* Chapman, 1915, (non Reuss, 1863), "Endeavour" Sci. Rept. vol. 3, pt. 1, p. 24, pl. 1, fig. 6.]

——— *dissona* (Plummer, 1931) var. *santanderensis* Cushman and Hedberg, **30,** p. 87, pl. 21, figs. 16–19. Upper Cretaceous, Colombia, South America.

Planulina crassa Galloway and Heminway, **47,** p. 398, pl. 25, fig. 2. Lower Miocene, Puerto Rico.

——— *zigzag* Galloway and Heminway, **47,** p. 400, pl. 26, fig. 4. Upper Oligocene, Puerto Rico.

PLANULINOIDES, gen. nov., Parr, **91,** p. 305. No family given. Genotype: *Discorbina biconcava* Jones and Parker, 1862, Introd. Study Foram., text fig. xxxii-G. Pliocene to Recent.

Pleurostomella elliptica Galloway and Heminway, **47,** p. 438, pl. 35, fig. 3. Oligo-Milcene, Puerto Rico. [For: *Pleurostomella alternans* Cushman and Harris, 1927, (non Schwager, 1866), Contr., Cushman Lab. Foram. Research, vol. 3, p. 129, pl. 25, fig. 28.]

——— *gerontica* Galloway and Heminway, **47,** p. 439, pl. 35, fig. 1. Oligo-Miocene, Puerto Rico.

Pliolepidina, see *Lepidocyclina*.

Polymorphina (*Sigmomorphina*) *simaensis* Makiyama and Nakagawa, **71,** p. 240, text fig. 1. Pleistocene, Japan.

Polymorphinella elongata Toulmin, **120,** p. 596, pl. 80, figs. 17, 18. Lower Eocene, Alabama.

——— *subcompressa* Toulmin, **120,** p. 596, pl. 80, figs. 19, 20. Lower Eocene, Alabama.

Proporocyclina, see *Pseudophragmina*.

Psammosphaera pusilla Parr, **94,** p. 106, pl. 1, figs. 6, 7. Permian, Western Australia.

——— *subsphaerica* Stewart and Priddy, **112,** p. 371, pl. 54, fig. 10. Silurian, Ohio.

Pseudarcella patella Galloway and Heminway, **47,** p. 298, pl. 1, fig. 1. Upper Oligocene, Puerto Rico.

PSEUDOCHRYSALIDINA, gen. nov., Cole, **16,** p. 35. Fam. Buliminidae. Subfam. Reussellinae. Genotype: *Pseudochrysalidina floridana* Cole, 1941. Middle Eocene.

——— *floridana* Cole, **12,** p. 36, pl. 1, figs. 10, 11; pl. 2, fig. 4. Middle Eocene, Florida.

Pseudogaudryina, see *Gaudryina*.

Pseudogaudryinella colombiana Cushman and Hedberg, **30,** p. 84, pl. 21, figs. 9, 10. Upper Cretaccous, Colombia, South America.

Pseudoglandulina acuta LeRoy, **64,** p. 27, pl. 2, figs. 1, 2. Mio-Pliocene, East Borneo.

——— *gallowayi* Cushman, 1929, var. *paucicostata* Cushman and Renz. **31,** p. 16, pl. 3, fig. 5. Miocene, Veneuzela.

Pseudononion papillatum Galloway and Heminway, **47,** p. 358, pl. 14, fig. 4. Upper Oligocene, Puerto Rico.

Pseudophragmina (*Athecocyclina*) *soldadensis* Vaughan and Cole, **125,** p. 62, pl. 19, figs. 4–8. Paleocene, Soldado Rock, Trinidad.

——— (*Proporocyclina*) *tobleri* Vaughan and Cole, **125,** p. 62, pl. 21, fig. 6; pl. 22, figs. 3, 4. Upper Eocene, Soldado Rock, Trinidad.

PSEUDORBITOIDINAE, subfam. nov., Rutten, **105,** p. 38. Fam. Orbitoididae. Genus: *Pseudorbitoides* H. Douvillé, 1922. Upper Cretaceous.

Pseudoschwagerina samegaiensis Huzimoto, **56,** p. 96, pl. 5, figs. 8–12. Basal Permian, Japan.

Pulvinulinella jarvisi Cushman and Renz, **31,** p. 24, pl. 4, fig. 4. Basal Miocene, Venezuela.

Quinqueloculina apiculata Galloway and Heminway, **47,** p. 302, pl. 2, fig. 2. Middle Oligocene, Puerto Rico.

——— *audacula* Galloway and Heminway, **47,** p. 302, pl. 1, fig. 7. Lower Miocene, Puerto Rico.

——— *maculata* Galloway and Heminway, **47,** p. 303, pl. 2, fig. 3. Middle Oligocene, Puerto Rico.

——— *ponceana* Galloway and Heminway, **47,** p. 304, pl. 2, fig. 5. Oligo-Miocene, Puerto Rico. [For: *Qyinqueloculina angusta* Galloway and Morrey, 1929, (non Philippi, 1843), Bull. Am. Paleontology, vol. 15, No. 55, p. 8, pl. 3, fig. 3.]

——— *pseudoreticulata* Parr, **91,** p. 305, not figured. Recent, South Australia. [For: *Miliolina reticulata* Brady, 1884 (non d'Orbigny, 1826), Challenger Exped., Zool., vol. 9, p. 177, pl. 9, figs. 2, 3 (non fig. 4). Brady's fig. 3 is the holotype.]

——— *reticulata* (d'Orbigny, 1826) var. *elongata* LeRoy, **65,** p. 71, pl. 5, figs. 13, 14. Mio-Pliocene, Siberoet Island, western Sumatra. (Note: The varietal name is preoccupied by *Quinqueloculina sarmatica* Karrer, 1877, var. *elongata* Karrer, 1877, Abh. k. k. geol. Reichs-Anst. Wien, vol. 9, p. 376, pl. 16a, fig. 11-b.)

Raibosammina irregularis Stewart and Priddy, **112,** p. 372, pl. 54, fig. 12. Silurian, Indiana.

Rectoeponides dalmatina Puyt, **98,** p. 67, pl. i, figs. 66, 67; pl. 2, fig. 3. Paleocene, Hercegovina, Yugo-Slavia.

REICHELINA, gen. nov., Erk. **42,** p. 249. Fam. Fusulinidae. Genotype: *Reichelina cribroseptata* Erk, 1941. Permian.

——— *cribroseptata* Erk, **42,** p. 250, pl. 14, figs. 17–21. Permian, Turkey.

——— *minuta* Erk, **42,** p. 251, pl. 13, figs. 15, 16; pl. 14, figs. 22–24. Permian, Turkey.

Reophax eckernex Vieaux, **126,** p. 625, pl. 85, fig. 1. Lower Cretaceous, Texas.

——— *subaster* Parr, **94,** p. 108, pl. 1, fig. 12. Permian, Western Australia.

——— *tricameratus* Parr, **94,** p. 109, pl. 1, fig. 13. Permian, Western Australia.

——— *woodbinensis* Tappan, **113,** p. 359, pl. 51, figs. 10–12. Upper Cretaceous, Texas.

Rhabdammina geniculata Stewart and Priddy, **112,** p. 369, pl. 54, fig. 1. Silurian, Indiana.

——— *minuta* Stewart and Priddy, **112,** p. 369, pl. 54, fig. 2. Silurian, Indiana.

——— *triradiata* Stewart and Priddy, **112,** p. 369, pl. 54, fig. 3. Silurian, Indiana.

Robulus cibaoensis Galloway and Heminway, **47,** p. 348, pl. 12, fig. 8. Upper Oligocene, Puerto Rico.

——— *evolutus* LeRoy, **65,** p. 73, pl. 7, figs. 26, 27. Mio-Pliocene, Siberoet Island, Sumatra.

——— *hedbergi* Cushman and Renz, **31,** p. 10, pl. 2, fig. 9. Oligo-Miocene, Venezuela.
——— *knighti* Toulmin, **120,** p. 578, pl. 78, fig. 21; text fig. 2-C. Lower Eocene, Alabama.
——— *magnificus* Toulmin, **120,** p. 578, pl. 78, fig. 22; text fig. 2-D. Lower Eocene, Alabama.
——— *nuttalli* Cushman and Renz, **31,** p. 11, pl. 2, fig. 10. Oligo-Miocene, Venezuela.
——— ——— var. *obliquicostata* Cuhsman and Renz, **31,** p. 11, pl. 2, fig. 11. Miocene, probably middle, Venezuela.
——— *melvilli* Cushman and Renz, **31,** p. 12, pl. 2, fig. 12. Miocene, Venezuela.
——— *multi-marginatus* LeRoy, **65,** p. 73, pl. 6, figs. 11, 12. Mio-Pliocene, Siberoet Island, western Sumatra.
——— *planulus* Cushman and Heminway, **47,** p. 350, pl. 11, fig. 14. Upper Oligocene, Puerto Rico.
——— *senni* Cushman and Renz, **31,** p. 12, pl. 2, figs. 14, 15. Middle to probably upper Miocene, Venezuela.
——— *suteri* Cushman and Renz, **31,** p. 10, pl. 2, figs. 5–8. Oligo-Miocene, Venezuela.
——— *sutura-rectus* LeRoy, **65,** p. 73, pl. 6, figs. 14, 15. Mio-Pliocene, Siberoet Island, western Sumatra.
Rotalia equatoriana LeRoy, **64,** p. 40, pl. 1, figs. 8–10. Mio-Pliocene, East Borneo.
——— *marginospinosa* LeRoy, **66,** p. 117, pl. 3, figs. 1–3. Plio-Pleistocene, western Java.
——— *meyerhoffi* Galloway and Heminway, **47,** p. 381, pl. 20, fig. 1. Oligo-Miocene, Puerto Rico.
——— *tholus* Galloway and Heminway, **47,** p. 382, pl. 20, fig. 2. Oligo-Miocene, Puerto Rico.
Rupertia verrucosa Galloway and Heminway, **47,** p. 403, pl. 27, fig. 9. Oligo-Miocene, Puerto Rico.

Saccammina aspera Stewart and Priddy, **112,** p. 372, pl. 54, fig. 13. Silurian, Indiana.
Sigmoilina latissima Chapman, **12,** p. 187, pl. 8, fig. 8. Recent, continental shelf, Australia.
Sigmomorphina, see *Polymorphina*.
Siphogenerina costostriata Galloway and Heminway, **47,** p. 432, pl. 34, fig. 5. Oligo-Miocene, Puerto Rico.
——— *cumingsi* Galloway and Heminway, **47,** p. 433, pl. 34, figs. 6, 7. Oligo-Miocene, Puerto Rico.
——— *hubbardi* Galloway and Heminway, **47,** p. 434, pl. 34, fig. 2. Oligo-Miocene, Puerto Rico.
——— *indica* LeRoy, **64,** p. 37, pl. 2, figs. 64, 65. Mio-Pliocene, East Borneo.
——— *kugleri* Cushman and Renz, **31,** p. 22, pl. 3, fig. 23. Miocene, Venezuela.
——— *senni* Cushman and Renz, **31,** p. 22, pl. 3, figs. 21, 22. Oligo-Miocene, Venezuela.
——— *yumuriana* Palmer, **89,** p. 185, pl. 15, figs. 3, 4. Upper Oligocene, Cuba. (Note: Mrs. Palmer states on p. 304 that this species should be placed into synonymy with *Siphogenerina senni* Cushman and Renz, 1941, ut supra).
Siphogenerinoides whitei Church, **13,** p. 182, fig. 67, no. 37. Upper Cretaceous, California.
SIPHONIDES, gen. nov., Feray, **44,** p. 174. Fam. Rotaliidae. Subfam. Siphonininae. Genotype: *Siphonides biserialis* Feray, 1941. Middle Eocene.
——— *biserialis* Feray, **44,** p. 174, test figs. 1–4. Middle Eocene, Claiborne, Texas.
Siphonina cojimarensis Palmer, **89,** p. 196, pl. 16, figs. 2, 5, 8. Upper Oligocene, Cuba.
——— *pozonensis* Cushman and Renz, **31,** p. 24, pl. 4, fig. 3. Oligo-Miocene, Venezuela.
Sorosphaera osgoodensis Stewart and Priddy, **112,** p. 371, p.. 54, fig. 11. Silurian, Ohio.
Sphaeroidinella rutschi Cushman and Renz, **31,** p. 25, pl. 4, fig. 5. Miocene, Venezuela.
Spiroclypeus bullbrooki Vaughan and Cole, **125,** p. 54, pl. 17, figs. 1–8. Oligocene, Trinidad.
Spirolina coryensis Cole, **16,** p. 33, pl. 1, figs. 5, 6. Middle Eocene, Florida.
Spiroloculina oculina Galloway and Heminway, **47,** p. 301, pl. 1, fig. 4. Lower Miocene, Puerto Rico.
Spiroplectammina expansa LeRoy, **65,** p. 69, pl. 1, figs. 22, 23; pl. 5, figs. 26–28. Mio-Pliocene, Siberoet Island, western Sumatra.
——— *marginoacuta* LeRoy, **64,** p. 19, pl. 2, figs. 111, 112. Mio-Pliocene, East Borneo.
SPIROSIGMOILINA, gen. nov., *Parr*, **92,** p. 361 (Published March, 1942.) Fam. Miliolidae. Genotype: *Spiroloculina tateana* Howchin, 1889, Trans. Roy. Soc. South Australia, vol. 12, p. 3, pl. 1, figs. 4, 5. Middle Miocene.
Streblus pauperatus Parr, **91,** p. 305. Not figured. Recent, South Australia. [For: *Rotalia perlucida* Parr, 1932, (non Heron-Allen and Earland, 1913) Proc. Roy. Soc. Victoria, vol. 44, new series, pt. 2, p. 231, pl. 22, fig. 35.]

Textularia coryensis Cole, **16,** p. 21, pl. 1, fig. 13. Middle Eocene, Florida.
——— *cuyleri* Davis, **37,** p. 147, pl. 24, figs. 3, 4. Upper Eocene, Texas.
——— *falconensis* Cushman and Renz, **31,** p. 3, pl. 1, fig. 3. Basal Miocene, Venezuela.
——— *dalmatina* Puyt, **98,** p. 45, pl. 1, figs. 4, 5. Paleocene, Hercegovina, Yugo-Slavia.
——— *diverga* Dorn in LeRoy, **64,** p. 19, pl. 2, figs. 11, 12. Mio-Pliocene, East Borneo.
——— *gertrudeana* Davis, **37,** p. 148, pl. 24, figs. 8, 14. Eocene, Texas.
——— *hannai* Davis, **37,** p. 149, pl. 24, figs. 11–13, 19. Middle Eocene, Texas.
——— *indenta* Calloway and Heminway, **47,** p. 331, pl. 8, fig. 8. Upper Oligocene, Puerto Rico. [For: *Textularia rugosa* Brady, 1884 (non Reuss, 1869), Challenger Exped., Zool., vol. 9, p. 363, pl. 42, fig. 24 (non fig. 23); and for: *Textularia rugosa* Cushman 1921, (non Reuss, 1869), U. S. Nat. Mus. Bull. 100, pt. 4, p. 114, pl. 23, figs. 3, 4.]
——— *isabelensis* Davis, **37,** p. 149, pl. 24, fig. 10. Miocene, Texas.
——— *isidroensis* Cushman and Renz, **31,** p. 4, pl. 1, fig. 7. Miocene, Venezuela.
——— *israelskyi* Davis, **37,** p. 150, pl. 24, fig. 23. Miocene, Texas.
——— *kugleri* Cushman and Renz, **31,** p. 5, pl. 1, figs. 8, 9. Miocene, Venezuela.
——— *lalickeri* Cushman and Renz, **31,** p. 3, pl. 1, figs. 4, 5. Basal Miocene, Venezuela.

——— *leuzingeri* Cushman and Renz, **31,** p. 3, pl. 1, fig. 2. Oligo-Miocene, Venezuela.
——— *mississippiensis* Cushman, 1922, var. *crockettensis* Davis, **37,** p. 150, pl. 24, figs. 11–13. Middle Eocene, Texas.
——— ——— ——— var. *elongata* Davis, **37,** p. 151, pl. 24, figs. 21, 22. Upper Eocene, Texas. (Note: The varietal name is preoccupied by *Textularia elongata* Hagenow, 1842, *Textularia elongata* Cornuel, 1848, and *Textularia elongata* d'Orbigny, 1852.)
——— *pozonensis* Cushman and Renz, **31,** p. 4, pl. 1, fig. 6. Miocene, Venezuela.
——— *sica* Lalicker and Bermúdez, **62,** p. 16, pl. 4, figs. 5, 6. Recent, off Cuba, 230 fathoms.
——— *stapperi* Davis, **37,** p. 152, pl. 25, fig. 16. Miocene, Texas.
Textulariella miocenica Cushman, 1936, var. *brevis* Cushman and Renz, **31,** p. 9, pl. 1, fig. 15. Oligo-Miocene, Venezuela.
Thurammina crescentrica Stewart and Priddy, **112,** p. 373, pl. 54, fig. 15. Silurian, Indiana.
Tinoporus baculatus (Montfort, 1808) var. *sphaericus* LeRoy, **65,** p. 85, p.. 5, fig. 40. Mio-Pliocene, Siberoet Island, western Sumatra.
Tolypammina undulata Parr, **94,** p. 104, pl. 2, fig. 2. Permian, western Australia.
Triloculina cervicula Galloway and Heminway, **47,** p. 306, pl. 3, fig. 3. Middle Oligocene, Puerto Rico.
——— *elliptica* Galloway and Heminway, **47,** p. 307, pl. 2, fig. 9. Middle Oligocene, Puerto Rico.
——— *longissima* Galloway and Heminway, **47,** p. 308, pl. 3, fig. 7. Middle Oligocene, Puerto Rico. [For: *?Triloculina oblonga* Cushman, 1922, (non Montagu, 1803), U. S. Geol. Surv., Prof. Pap. 129-E, p. 104, pl. 28, figs. 3, 4.]
TRISTIX, gen. nov., Macfadyen, **69a,** p. 54. Fam. Lagenidae. Genotype: *Rhabdogonium liasinum* Berthelin, 1879, Rev. Mag. Zool., series 3, vol. 7, p. 35, pl. i, figs. 18, 19. Lower Liassic.
Trochammina prima Stewart and Priddy, **112,** p. 375, pl. 54, figs. 23–25. Silurian, Indiana.
——— *subobtusa* Parr, **94,** p. 109, pl. 1, fig. 14. Permian, Western Australia.
Trochamminoides approximatus Galloway and Heminway, **47,** p. 319, pl. 6, fig. 1. Lower Miocene, Puerto Rico.

Uvigerina auberiana d'Orbigny, 1839, var. *attenuata* Cushman and Renz, **31,** p. 21, pl. 3, fig. 17. Miocene, Venezuela.
——— *bulbacea* Galloway and Heminway, **47,** p. 427, pl. 33, figs. 1, 2. Upper Oligocene, Puerto Rico.
——— *coartata* Palmer, **89,** p. 304. Upper Oligocene, Cuba. [Nomen novum for: *Uvigerina compressa* Palmer, 1941, ut infra.]
——— *compressa* Palmer, **89,** p. 182, pl. 15, figs. 10, 11. Upper Oligocene, Cuba. (Note: Mrs. Palmer has changed this species name to *Uvigerina coartata* Palmer, 1941, ut supra, for being a homonym of *Uvigerina compressa* Cushman, 1925, Contr. Cushman Lab. Foram. Research, vol. 1, p. 10, pl. 4, fig. 2.)
——— *fusiformis* Galloway and Heminway, **47,** p. 428, pl. 33, fig. 6. Oligo-Miocene, Puerto Rico.
——— *gallowayi* Cushman, 1929, var. *basicordata* Cushman and Renz, **31,** p. 21, pl. 3, fig. 18. Basal Miocene, Venezuela.
——— *isidroensis* Cushman and Renz, **31,** p. 20, pl. 3, fig. 16. Oligo-Miocene, Venezuela.
——— *juncea* Cushman and Todd, **33,** p. 78, pl. 20, figs. 4–11. Pliocene, California.
——— *mexicana* Nuttall, 1932, var. *bulbosa* Galloway and Heminway, **47,** p. 431, pl. 33, fig. 10. Oligo-Miocene, Puerto Rico.
——— ——— ——— var. *ranunculus* Galloway and Heminway, **47,** p. 431, pl. 33, fig. 11. Oligo-Miocene, Puerto Rico.
——— *postica* Galloway and Heminway, **47,** p. 431, pl. 33, figs. 3, 4. Upper Oligocene, Puerto Rico.
——— *rutila* Cushman and Todd, **34,** p. 78, pl. 20, figs. 16–22. Lower Pliocene, Algiers, northern Africa.

Vaginulina barcoensis Cushman and Hedberg, **30,** p. 90, pl. 22, fig. 2. Upper Cretaceous, Colombia, South America.
——— *dalmatina* Puyt, **98,** p. 53, pl. 1, figs. 46–48. Paleocene, Hercegovina, Yugo-Slavia.
——— *faba* Galloway and Heminway, **47,** p. 335, pl. 9, fig. 3. Oligo-Miocene, Puerto Rico. [For: *Marginulina* sp. Howe and Wallace, 1932, Louisiana Geol. Bull. no. 2, p. 34, pl. 7, fig. 3.]
——— *siliquoidea* Galloway and Heminway, **47,** p. 336, pl. 9, fig. 5. Oligo-Miocene, Puerto Rico. [For: *Vaginulina legumen elegans* d'Orbigny in Cushman, 1923, U. S. Geol. Surv. Prof. Pap. 133, p. 30, pl. 4, fig. 8.]
Vaginulinopsis exquisita Toulmin, **120,** p. 583, pl. 79, fig. 7. Lower Eocene, Alabama.
Valvulammina cornucopia Galloway and Heminway, **47,** p. 320, pl. 6, fig. 4. Middle Oligocene, Puerto Rico.
Valvulina flexilis Cushman and Renz, **31,** p. 7, pl. 1, figs. 16, 17. Oligo-Miocene, Venezuela.
——— *floridana* Cole, **16,** p. 21, pl. 1, figs. 1, 2. Middle Eocene, Florida.
Valvulineria inaequalis (d'Orbigny, 1839) var. *lobata* Cushman and Renz, **31,** p. 23, pl. 3, fig. 24. Miocene, Venezuela.
——— *maclureaeformis* Galloway and Heminway, **47,** p. 369, pl. 16, fig. 1. Upper Oligocene, Puerto Rico.
Vulvulina jacuraensis Cushman and Renz, **31,** p. 5, pl. 1, fig. 10. Oligo-Miocene, Venezuela.

LIST OF FORMS WITH NOMENCLATURA APERTA

Amphistegina sp. indet. Vaughan and Cole, **125,** p. 77, pl. 45, fig. 3. Upper Eocene, Soldado Rock, Trinidad.
Baculogypsina sp. Rao, **100,** p. 17, pl. 2, fig. 6. Eocene, India.
Baggina sp. LeRoy, **66,** p. 117, pl. 2, figs. 4–6. Plio-Pleistocene, Java.

Bifarina sp. Toulmin, **120,** p. 599, pl. 80, fig. 29. Lower Eocene, Alabama.
Bolivina sp. Cushman, **22,** no description, pl. 5, fig. 3. Recent, Caribbean Sea.
——— sp. Cushman, **22,** no description, pl. 5, fig. 4. Recent, Caribbean Sea.
——— sp. Ferguson, **45,** p. 246, fig. 98, no. 2. Pliocene, California.
——— sp. Hanna and Hertlein, **52,** p. 180, fig. 67, Nos. 24, 25. Upper Miocene, California.
Bulimina sp. Cushman, **22,** no description, pl. 5, fig. 8. Recent, Caribbean Sea.
Buliminella sp. Chapman, **12,** p. 165, not figured. Recent, Australian continental shelf. [For: *Bulimina elegantissima* d'Orbigny 1839 var. *seminuda* Brady, 1884 (non Terquem, 1882).]
Carpenteria sp. Palmer, **89,** p. 300, pl. 28, fig. 4. Upper Oligocene, Cuba.
Cibicides sp. Cushman and Hedberg, **30,** p. 100, pl. 23, fig. 22. Upper Cretaceous, Colombia.
Cornuspira sp. Puyt, **98,** p. 48, pl. 1, fig. 15. Paleocene, Hercegovina, Yugo-Slavia.
——— sp. Toulmin, **120,** p. 576, pl. 78, fig. 15. Eocene, Alabama.
Cyclammina sp. Ferguson, **45,** p. 246, fig. 98, no. 2; no description and no age given.
Darbyella? sp. Toulmin, **120,** p. 581, pl. 78, figs. 31, 32; text fig. 2-F. Eocene, Alabama.
Dentalina sp. Cushman, **22,** no description, pl. 6, fig. 5. Recent, Caribbean Sea.
——— sp. Cushman and Hedberg, **30,** p. 89, pl. 21, fig. 29. Upper Cretaceous, Colombia.
Discocylina (*Asterocyclina*) sp. indet., Vaughan and Cole, **125,** p. 61, Upper Eocene, Trinidad.
Discorbis sp. A Toulmin, **120,** p. 600, pl. 80, fig. 37; text figs. 4-H, 4-I. Lower Eocene, Alabama.
——— sp. B Toulmin, **120,** p. 600, pl. 81, figs. 1, 2; text fig. 4-D. Lower Eocene, Alabama.
Elphidium sp. Cushman, **24,** p. 34, pl. 9, fig. 10. Plio-Pleistocene, Alaska.
Entosolenia sp. A LeRoy, **64,** p. 33, pl. 2, figs. 59–61. Mio-Pliocene, East Borneo.
——— sp. B LeRoy, **65,** p. 80, pl. 1, figs. 35, 36. Mio-Pliocene, Siberoet Island, Sumatra.
Eponides sp. A Ferguson, **45,** p. 245, fig. 97, no. 1. Pliocene, California.
——— sp. B. Ferguson, **45,** p. 245, fig. 97, no. 2. Pliocene, California.
——— sp. A LeRoy, **64,** p. 40, pl. 3, figs. 7–9. Mio-Pliocene, East Borneo.
——— sp. B LeRoy, **65,** p. 84, pl. 7, figs. 7–9. Mio-Pliocene, Siberoet Island, Sumatra.
——— sp. Puyt, **98,** p. 67, pl. 1, figs. 55, 56. Paleocene, Hercegovina, Yugo-Slavia.
Flabellinella (*?*) sp. Leoblich and Tappan, **67,** p. 21, pl. 3, fig. 1. Lower Cretaceous, Texas.
Frondicularia sp. Cushman and Hedberg, **30,** p. 91, pl. 22, fig. 5. Upper Cretaceous, Colombia.
——— sp. A Loeblich and Tappan, **67,** p. 17, pl. 3, fig. 9. Lower Cretaceous, Texas.
——— sp. B Loeblich and Tappan, **67,** p. 18, pl. 3, fig. 8. Lower Cretaceous, Texas.
Fusulinella sp. Ozaki, **88,** p. 52, text fig. 1. Paleozoic, Japan.
Globotruncana sp. Palmer, **89,** p. 291, pl. 29, fig. 2. Upper Oligocene, Cuba.
Hemicristellaria sp. A LeRoy, **64,** p. 28, pl. 2, figs. 59, 60. Mio-Pliocene, East Borneo.
Lagena sp. Cushman, **22,** no description, pl. 6, figs. 1–4. Recent, Caribbean Sea.
——— sp. A LeRoy, **64,** no description, pl. 3, fig. 52. Mio-Pliocene, East Borneo.
———? sp. Puyt, **98,** p. 54, pl. 1, fig. 18. Paleocene, Hercegovina, Yugo-Slavia.
Leeina? sp. Anderson, **1,** p. 194, pl. 2, fig. 2. Permo-Carboniferous, Washington, U. S. A.
Lepidocyclina (*Lepidocyclina*) sp. indet. no. 1 Vaughan and Cole, **125,** p. 68, pl. 33, figs. 1, 2. Upper Eocene, Trinidad.
——— sp. indet. no. 2 Vaughan and Cole, **125,** p. 69, pl. 33, fig. 3, 4. Upper Eocene, Trinidad.
——— sp. indet. no. 3 Vaughan and Cole, **125,** p. 75, pl. 40, figs. 5, 6. Oligocene, Trinidad.
Lituolidae nov. gen.? nov. sp.? Puyt, **98,** p. 45, pl. 1, figs. 1–3. Paleocene, Hercegovina, Yugo-Slavia.
Lituonella? sp. Vaughan and Cole, **125,** p. 31, pl. 8, fig. 1. Oligocene, Trinidad.
Loxostoma sp. Toulmin, **120,** p. 598, pl. 80, fig. 28. Lower Eocene, Alabama.
Loxostomum sp. A. LeRoy, **64,** p. 35, pl. 2, figs. 32, 33. Mio-Pliocene, East Borneo.
Marginulina mexicana (Cushman) var. A Laiming, **61,** p. 198, fig. 83, no. 4. Eocene, California.
——— ——— var. B Laiming, **61,** p. 198, fig. 83, no. 5. Eocene, California.
——— ——— var. C. Laiming, **61,** p. 198, fig. 83, no. 6. Eocene, California.
——— ——— var. D Laiming, **61,** p. 198, fig. 83, no. 7. Eocene, California.
Miogypsina sp. Rao, **100,** p. 17, pl. 2, fig. 5. Burdigalian, western British India.
Miscellanea sp. cf. *M. soldadensis* Vaughan and Cole, **125,** pp. 18, 24, pl. 4, fig. 10, Paleocene, Soldado Rock, Trinidad.
Nodosaria sp. A Puyt, **98,** p. 53, pl. 1, fig. 35. Paleocene, Hercegovina, Yugo-Slavia.
——— sp. B Puyt, **98,** p. 53, pl. 1, fig. 31. Paleocene, Hercegovina, Yugo-Slavia.
Nonion sp. Goudkoff, **49,** p. 252, fig. 101, no. 2. Oligocene, California.
——— sp. Hanna and Hertlein, **52,** p. 180, fig. 67, nos. 29, 30. Upper Miocene, California.
——— sp. Puyt, **98,** p. 57, pl. 1, fig. 19. Paleocene, Hercegovina, Yugo-Slavia.
Operculina sp. Puyt, **98,** p. 59, pl. 2, fig. 30. Paleocene, Hercegovina, Yugo-Slavia.
Orbitolina sp. Vaughan and Cole, **125,** p. 31, pl. 8, figs. 2–4. Cretaceous, Trinidad.
Patellina sp. Toulmin, **120,** p. 599, pl. 80, figs. 31, 32. Lower Eocene, Alabama.
Patellinella? sp. Toulmin, **120,** p. 600, pl. 80, fig. 34. Lower Eocene, Alabama.
Patellinoides? sp. Toulmin, **120,** p. 599, pl. 80, fig. 33. Lower Eocene, Alabama.
Planispirina? sp. A. LeRoy, **65,** p. 72, pl. 7, figs. 29, 30. Mio-Pliocene, Siberoet Island, western Sumatra.

Planularia sp. Cushman and Hedberg, **30,** p. 87, pl. 21, fig. 15. Upper Cretaceous, Colombia.
——— sp. B LeRoy, **65,** p. 74, pl. 7, fig. 28. Mio-Pliocene, Siberoet Island, Sumatra.
Pseudoglandulina sp. Goudkoff, **49,** p. 252, fig. 101, no. 1. Lower Miocene, California.
——— sp. B LeRoy, **65,** p. 76, pl. 5, fig. 31. Mio-Pliocene, Siberoet Island, Sumatra.
Pseudouvigerina sp. A Laiming, **61,** p. 198, fig. 83, no. 1. Eocene, California.
——— sp. B Laiming, **61,** p. 198, fig. 83, no. 2. Eocene, California.
——— sp. C Laiming, **61,** p. 198, fig. 83, no. 3. Eocene, California.
Pullenia sp. A LeRoy, **65,** p. 86, pl. 6, figs. 22, 23. Mio-Pliocene, Siberoet Island, Sumatra.
Pulvinulinella sp. Cushman, **24,** p. 38, pl. 9, fig. 21. Plio-Pleistocene, Alaska.
Pyrgoella sp. Cushman, **22,** no description, pl. 6, fig. 9. Recent, Caribbean Sea.
Quinqueloculina sp. A Cushman, **22,** no description, pl. 6, figs. 13–17. Recent, Caribbean Sea.
——— sp. B Cushman, **22,** no description, pl. 6, figs. 18, 19. Recent, Caribbean Sea.
——— sp. B LeRoy, **64,** p. 22, pl. 3, figs. 20–22. Mio-Pliocene, Borneo.
——— sp. C LeRoy, **64,** p. 22, pl. 3, figs. 23–25. Mio-Pliocene, Borneo.
——— sp. D LeRoy, **64,** p. 22, pl. 3, figs. 82, 83. Mio-Pliocene, Borneo.
——— sp. F LeRoy, **65,** p. 71, pl. 5, figs. 3, 4. Mio-Pliocene, Siberoet Island, Sumatra.
——— sp. G LeRoy, **66,** p. 112, pl. 3, figs. 10–12. Plio-Pleistocene, Java.
Robertina sp. Cushman, **22,** no description, pl. 6, fig. 21. Recent, Caribbean Sea.
Robulus sp. A LeRoy, **64,** p. 25, pl. 3, figs. 60, 61. Mio-Pliocene, East Borneo.
——— sp. B LeRoy, **64,** p. 25, pl. 3, figs. 82, 83. Mio-Pliocene, East Borneo.
Rotalia sp. A LeRoy, **65,** p. 84, pl. 7, figs. 4–6. Mio-Pliocene, Siberoet Island, Sumatra.
Siderolites sp. Rao, **101,** p. 66, pl. 6, fig. 4. Upper Cretaceous, southern British India For: *Orbitoides minor* Vredenburg, 1908 (non Schlumberger, 1902), Rec. Geol. Surv. India, vol. 36, p. 205, pl. 28, fig. 1.
Siphonodosaria sp. Cushman, **22,** no description, pl. 6, fig. 20. Recent, Caribbean Sea.
Sporadotrema sp. Palmer, **89,** p. 301, pl. 31, fig. 1. Upper Oligocene, Cuba.
Staffella sp. Ozaki, **87,** p. 51, text fig. 2. Paleozoic, Japan.
——— sp. Ozaki, **88,** p. 52, text fig. 2. Paleozoic, Japan.
Textularia sp. A Puyt, **98,** p. 46, pl. 1, fig. 8. Paleocene, Hercegovina, Yugo-Slavia.
——— sp. B Puyt, **98,** p. 46, pl. 1, fig. 9. Paleocene, Hercegovina, Yugo-Slavia.
——— sp. C Puyt, **98,** p. 46, pl. 1, fig. 10. Paleocene, Hercegovina, Yugo-Slavia.
Thurammina sp. Stewart and Priddy, **112,** p. 373, pl. 54, fig. 17 (non fig. 4). Silurian, Indiana.
Uvigerina sp. A LeRoy, **64,** p. 36, pl. 1, figs. 49, 50. Mio-Pliocene, East Borneo.
Vaginulina sp. Toulmin, **120,** p. 592, pl. 79, fig. 36. Eocene, Alabama.
Verneuilina sp. Cole, **16,** p. 21, pl. 1, fig. 14. Eocene, Florida.
Virgulina sp. A. LeRoy, **64,** p. 33, pl. 2, figs. 26, 27. Mio-Pliocene, Borneo.

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REVIEWS

CONDRA, G. E. and ELIAS, M. K., Study and revision of *Archimedes* (Hall): Geol. Soc. America Spec. Papers, no. 53, viii+243 pp., 6 figs., 41 pls. (Feb. 29, 1944).

This work is a comprehensive study of the occurrence, morphology, taxonomy, and biological relationships of so-called *Archimedes*.

Geographic occurrence of this organism in the United States and in other countries is carefully documented and even its nonoccurrence is briefly discussed. Its stratigraphic range extends from the Upper Silurian (where *Helicopora* is a possible repesentative) to the Lower Permian. Recognized species occur as follows: Upper Silurian, 1; Devonian, 1; Mississippian, at least 30; Pennsylvanian, 8, Lower Permian, 2. Individual species have rather restricted ranges and are therefore good guide fossils. Investigation of all purported occurrences of post-Mississippian *Archimedes* in America results in its undoubted recognition only in the lower Pennsylvanian of Utah.

The authors have attempted to make a comprehensive and balanced study of both megascopic and microscopic characteristics of *Archimedes*. Their work appears to be exhaustive and is based in considerable part upon extensive material which they personally collected.

In the discussion of the taxonomic relationships of *Archimedes*, Condra and Elias argue that the name *Archimedipora* cannot replace *Archimedes*[1] and they conclude that there "is no sharp distinction between *Helicopora* and *Archimedes*." One species is tentatively left in *Helicopora* because of insufficient data and lack of comparative material. A very detailed review is presented of the taxonomic position of *Fenestella* whose status is so confused that it nearly defies analysis. The authors have appealed to the International Commission of Zoological Nomenclature for a ruling on this problem.

The morphology of *Archimedes* is treated in detail. Three types of flanges and five types of growth forms are distinguished. A section on the morphology of the frond is also presented. The microstructure of incrusting tissue is discussed, including a review of previous work and addition of much original data. The authors are especially concerned with the texture of the encrusting material and base their conclusions that it is probably algal on textural characteristics.

They point out in a summary of essential structural features that: 1, the frond consists of *Fenestella*, and *Archimedes* screws arise from its edges; 2, encrusting tissue covers both sides of the frond and forms the twisted screw; 3, the fibrous tissue appears to twist either to the right or left on the shaft but may reverse on the flange; 4, the fibrous tissue may become interwoven with itself and seems to envelop rather than penetrate the bryozoan tissue; 5, needles which may exist on the obverse side of the frond apparently are not morphologically connected with either the frond or the fibrous tissue; 6, the flange is formed by bifurcation of individual fibers of the encrusting tissue which maintain uniform diameter; 7, some fibers near the edge of the flange expand into bead-like globules; 8, some fibers are arranged in groups which flatten at the edge of the flange and extend onto both sides of the frond, following its sculpture; 9, single adventitious screws arising from the edge of a frond may twist in either direction, but two closely adjacent screws either rise from the edge of a frond and always twist in opposite directions, or arise by bifurcation of a single screw and twist in the same direction; 10, the fibers "seem to contain very faint and delicate transverse partitions."

Condra and Elias attribute the shape of the *Archimedes* screw to the action of currents. They believe that: 1, the colonies grew upright from the ocean floor; 2, bits of algae settled at the edge of fronds; 3, the concerted action of bryozoan polypides created locally controlled currents which in part governed the shape of the colonies; and 4, there was actual mechanical twisting or torque developed in the axes, as demonstrated by twisting and bunching of the fibers. They also believe that the whirlpool effect of eddies in the lee of two adjacent colonies would cause them to twist in opposite directions.

Although Condra and Elias argue that

[1] See "Comments" by the writer following this review.

some plant (probably an alga) is symbiotically associated with a bryozoan to make "*Archimedes*" colonies, they recognize "species" upon the characters of the two organisms together. Their stand is stated thus (p. 54):

"The validity of the species of *Archimedes*, and even of the genus itself, depends upon the understanding and definition of the genus as an organism. . . . In our understanding of *Archimedes* the knowledge of the type of screw is as essential for recognition of its species as is the knowledge of its meshwork."[1] They also state (p. 61) "that the understanding of *Archimedes* as a biologic consortium opens a new approach for the taxonomic revision of these fossils."

Condra and Elias propose (p. 61) that "only the fronds of *Fenestella* type attached to flanges of a screw or reasonably proved to be their broken portions—but not when they belong to *Fenestella* colony which served as its base—should be classified as *Archimedes*. In doubtful cases the fragments of *Fenestella* type should be placed rather in the genus *Fenestella* than in *Archimedes*." In accordance with this view, the authors describe some "species" as *Archimedes* and others as *Fenestella*.

The remaining portion of the paper is mostly devoted to the description and redescription of species, including many tables of variation in morphologic features. Conclusions and several keys and charts showing ranges and comparison of species complete the text proper. Synonymies are apparently restricted to citations which have been checked from specimens or illustrations. Numerous citations are ignored, hence, much additional collecting and study is necessary to establish the stratigraphic ranges of some species.

In spite of objections that may be raised to some of Condra and Elias' views this work will be of interest to all students of Bryozoa. Unfortunately, the paper did not receive more critical and severe editing. Sentence structure at many places is peculiar, consequently the intended meaning is obscure. Choice of words is not always good and some meanings that are implied are obviously not those that existed in the authors' minds. Certain parts, such as descriptions of flange types of growth forms (pp. 20–21) are extremely obscure. All the morphologic features should have been fully illustrated with line drawings. Mistaken references of type specimens to the Illinois Geological Survey rather than to the University of Illinois exist (pp. 81, 83). Parentheses, proper for a subgenus, are used to indicate equivalence (*Helicopora*, p. 69). Plate illustrations are abundant but some of the figures apparently show nothing of significance. Several plates are inconveniently arranged sidewise rather than vertically and figures on one (pl. 36) are not consistently numbered in either arrangement.

COMMENTS

This study of *Archimedes* obviously has involved the intensive and careful examination of a vast amount of material. Much information, some undoubtedly of great significance, has been brought to light for the first time. However, the authors' points of view with regard to certain matters and their conclusions regarding other matters are unorthodox, to say the least, and require comment.

The conclusions of Condra and Elias that *Archimedipora* does not take precedence over *Archimedes* certainly cannot be maintained. They state "from the taxonomic point of view the Rules of Nomenclature should be applied to this as any other taxonomic problems" but they do not so apply the Rules. I agree that "nearly universal acceptance of the name *Archimedes*" makes it desirable to retain the name" but universal acceptance assuredly does not imply that it "might be used as an argument for its retention."

Their argument in brief is (1) that *Archimedipora* must have a valid species for its genotype but (2) that *Retepora archimedes*, the genotype, is invalid, and (3) that a neotype cannot be designated because the type locality is not known. Let us examine these points in the light of the International Rules of Zoological Nomenclature.

1. Their statement "A genus must have a valid species for genotype" is utterly unfounded. A genus proposed before 1931 does not have to have a genotype at all, much less a valid species (see art. 25). Many genera have been validly proposed without the designation of a genotype. Most have since

had genotypes designated for them but some still remain without genotypes (see *Trochotremaria*, Knight, 1941, p. 360). Such names may not be useful at present but they are certainly available.

2. The foregoing argument is unimportant in this case, however, because *Archimedipora* does have a genotype, *Retepora archimedes*. Condra and Elias state that this species "is invalid because its zooecial meshwork has not been illustrated or described." Failure of the original author to illustrate or describe the meshwork may result in this species being unrecognizable but it certainly does not make it invalid or render its name unavailable. There is nothing in the Rules that demands the recognition of a complete organism, let alone its complete illustration or description (see art. 27, *a*). One can imagine the taxonomic confusion that would result if species of fossil vertebrates were to be ruled invalid unless they were founded on relatively complete skeletons.

3. The authors state "The designation by Easton for neotypes of *Archimedipora archimedes* (Owen) of the same specimens which serve as types of *Archimedes wortheni* is inacceptable because a topotype must be selected for the neotype, and none is obtainable because the locality of *Archimedipora archimedes* is unknown." As a matter of fact, neotypes are entirely without standing as far as the Rules are concerned and there is certainly nothing in the Rules that can be construed as a demand that a neotype must be a topotype. This argument, however, loses all significance as far as Condra and Elias are concerned because at another place (p. 88) they themselves abandon their own precept to designate as neotype of *Archimedes grandis* Ulrich a specimen which is not a topotype.

My own stand in this matter may be summarized as follows:

1. The fact that *Retepora archimedes* Owen is the genotype of *Archimedipora* d'Orbigny is doubly established by article 30, I, *c*, of the Rules (by monotypy) and by the following paragraph *d* (by tautonymy).

2. *Retepora archimedes* was inadequately described and its type has been lost.

3. The genotype of *Archimedes* is *A. wortheni* Hall, established by application of article 30, II, *g*.

4. *A. wortheni* is adequately described and its type specimens are preserved.

5. *R. archimedes* and *A. wortheni* have been considered to be synonymous names for more than 40 years (Bassler and Nickles, 1900, pp. 168, 169).

6. *Archimedipora* d'Orbigny, 1847, has clear priority over *Archimedes* Hall, 1857.

7. *Archimedipora* and *Archimedes* are unquestionably synonymous names. This is admitted by Condra and Elias who state that the illustration of *Retepora archimedes* shows "a typical screw congeneric with *Archimedes* Hall." *Quod erat demonstrandum.*

It seems to me that the only satisfactory solution to this problem is the one I proposed in 1943. It is simple, it requires the shifting of two names, but no change in the concepts involved. It necessitates only the assumption that *A. wortheni* is a junior subjective synonym of *R. archimedes*, for which there is ample precedent. By accepting the holotype of *A. wortheni* as the neotype of *R. archimedes* the latter species becomes recognizable and *Archimedipora* is thus provided with a well-known genotype. Otherwise, we are provided with a ghost to lay.

Although Condra and Elias present their consortium hypothesis with considerable assurance they appear to be aware that few paleontologists will fully accept it until this matter has been more fully discussed and investigated by others. A future publication by Elias is promised in which further details will be presented.

Some neontologists are skeptical of all supposed symbiotic relationships, considering them to be merely degrees of parasitism, and most biologists require extensive proof of physical or physiological benefit before accepting two organisms as symbionts. Inasmuch as the supposed symbiotic relationship of fossil organisms is almost if not entirely a subjective problem this hypothesis will undoubtedly be viewed with reserve.

If the encrusting tissue is an algal growth, it surely existed independently of the bryozoan. If it be argued that it couldn't live without the byrozoan, then the relationship is not one of symbiotism but simple parasitism. Condra and Elias certainly have not proved the existence of symbiosis in "*Archimedes.*" Should they be successful in overcoming the various objections that will un-

doubtedly be raised they will have established one of the most complex plant-animal coactions known to science.

The "oblique braces" figured by me (Easton, 1943, pl. 23, fig. 13) are almost certainly organs of support extending between the axis and one or more fronds or even between the meshwork and the ocean floor. If so, it is almost inconceivable that an alga, at first supported by a bryozoan, would later reciprocate and provide a convenient physical support for its host.

The fact that the "encrusting tissue" does not resemble the bryozoan skeleton in texture does not necessarily mean that the two were deposited by different organisms. Two or more different kinds of skeletal tissue occur commonly in many organisms. The layered or fibrous nature of the encrusting tissue might be the result of successive noncontinuous deposits of skeletal material secreted by the bryozoan after the frond developed and therefore it would not be intergrown with the frond. Condra and Elias (p. 46) suggest that the alga obtained calcareous material only from the bryozoan and actually secreted none of its own origin. This idea needs considerable proof from study of modern algae before the writer will accept it.

The plan of new meshwork in space is supposed to be controlled by the currents set up in already established portions, thus mounting up along the axial structure. It hardly seems reasonable that a frond would grow in some rigidly established plan if that course led to a life or death struggle between some polypides and an encrusting organism. Whatever the axial material may be, it may very well have grown there after the plan of the frond was attained. Condra and Elias (p. 41) believe that the "Vitalizing effect of the phytomorph did not in itself produce coiling but rather resulted in vigorous localized growth of parts which became coiled." Is not this sentence contradictory?

There appears to be no valid reason why algal fragments should always come to rest precisely at the edge of a *Fenestella* frond but there seems to be no known instance of encrusting tissue starting to grow elsewhere. To me it is more reasonable that the supposed *Fenestella* was a fragment of an "*Archimedes*" colony from whose growing edge an adventitious axis originated because of an inherent tendency in the bryozoan colony.

In the text the authors describe not only species of *Fenestella* but also "species" of "*Archimedes*" that are supposed to have developed from the *Fenestella* species. They believe that the presence of algae in "*Archimedes*" resulted in recognizable alteration in gross geometrical plan of meshwork growth, although it is difficult to see why an alga should affect bryozoan growth at some distance from the axis and where no encrusting tissue is present.

Condra and Elias believe that "species" of "*Archimedes*" can be distinguished only on the basis of both axis and meshwork. According to their view "species" may be similar in meshwork but different in axial characters or vice versa. Presumably, although they make no statement on this matter, this situation demands that several species of *Fenestella* and several species of algae were capable of combining more or less indiscriminately to form "species" of "*Archimedes*." They nowhere describe differences in encrusting tissue that might indicate the existence of different species of algae. If several algae could be involved with one or more bryozoans it would be most remarkable and would apparently indicate a degree of adaptability in the interrelations of various species rarely encountered in symbiotic organisms.

If "*Archimedes*" is a composite organism, regardless of whether the relationship was one of symbiosis or parasitism, the recognition of various combinations as "species" is, to say the least, a dubious procedure. There is no provision in the Zoological Rules to warrant such procedure but because one of the associated organisms is supposed to be a plant, Botanical Rules, which are somewhat different, might provide argument to warrant it.

Condra and Elias' argument that twisting of the *Archimedes* screw resulted from the action of currents (originally as eddies set up in back of small obstacles and subsequently as currents maintained by the concerted action of the polypides) is unconvincing. If twisting were caused by the above mechanical means much greater variation than is known to exist within a "species"

could be expected, because the pitch of the flanges on the "screws" would be initially controlled by the angle between the axis of the screw and the plane of the early meshwork; if the screws tend to become vertical, as claimed, then the pitch of the flanges is actually a function of the fortuitous slope of the early fronds.

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WM. H. EASTON

EOCENE OF VIRGINIA, by Benjamin Gildersleeve. Virginia Geological Survey, Bulletin 57, University, Virginia, 1942 (43) 43 pages, 2 figures, 6 plates.

This bulletin discusses the two formations of Eocene age that outcrop in Virginia, the Nanjemoy and the Aquia. An introductory section deals with previous work on the Virginia Eocene and a description of the topography of the region. The stratigraphy of the formations is described and their extent, lithology, thickness, subdivisions and relation to other formations are outlined. A brief section is devoted to correlation.

The main portion of the report (pp. 18–30) consists of the description of twenty-eight Eocene localities distributed along the valleys of the Potomac, Rappahannock, Mattaponi, Pamunkey, and James rivers. Detailed sections and lists of both macrofossils and Foraminifera are given for each locality. It does not cover all Eocene outcrops in the region but the selection is fairly representative.

In conclusion brief sections are devoted to the geological history of the region, analyses of the fauna and flora, and a discussion of the mineral resources with special emphasis on greensand marl which has at least some potential value.

Illustrations include a sketch map, views of several localities and photomicrographs

This bulletin is an excellent, easily understood, abbreviated summary of the Eocene of Virginia. In a way, it supplants a portion of Bulletin 4 of the Virginia Geological Survey[1] which is now out of print. It would have been improved, however, by the addition of one or more plates showing characteristic fossils and a more detailed map.

The reviewer recently spent several days studying the Eocene of Virginia. He found this report useful both in locating exposures in the field and in studying the specimens in the laboratory.

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AN INTRODUCTION TO POLLEN ANALYSIS (with a foreword by Roger P. Wodehouse). By G. Erdtman. 239 pp., 18 ch., 28 plates, 3 portrait plates, 15 text figs.; new series Plant Science Books, vol. 12; Waltham, Mass.: Chronica Botanica Company; New York: G. E. Stechert and Company. 1943. $5.00.

This excellent book by the Swedish botanist, G. Erdtman, should be of special interest to pollen analysts, paleobotanists, botanists, coal geologists and chemists, as well as numerous others in closely allied fields of research.

The historical introductory chapter gives an excellent account of the birth of pollen analysis in Europe but only one American worker is included in the list of references.

That portion of the book devoted to the chemistry of peat, which was written by H. Erdtman, should be of special interest to coal geologists and paleobotanists. It is most unfortunate that Dr. S. A. Waksman's important contribution in 1942 is not included, although a footnote on page 9 indicates that Dr. Waksman was consulted in preparing this chapter for the press. This chapter adequately covers the carbohydrates of wood, lignin, humic acids, the preservation of organized material, and the preservation of pollen and spores in peat. The chemistry of pollen and spore membranes is admittedly almost a virgin field for research.

[1] W. B. Clark, Miller, B. L. et al., Physiography and geology of the Coastal Plain province of Virginia: Virginia Geol. Survey Bull. 4 (1912).

Chapters three and four are of particular value to pollen analysts and paleobotanists. The author goes into great detail in describing various methods and techniques of pollen preparation. Although some may object to lengthy directions, and some pollen analysts may be familiar with the details, they will be useful to many.

The 96 pages devoted to the pollen and spore morphology of the various plant groups is preceded by an excellent general chapter. The glossary on pages 49 to 52 is of special interest as is text figure 5 which illustrates the types of exine ornamentation. The chapters on pollen morphology of the spermatophytes and spore morphology of the pteridophytes should be very useful to the pollen analysts, botanists, and paleobotanists.

Sixteen pages are devoted to the graphic presentation of the results of pollen analyses. I am inclined to believe that the simplest form of graph is preferable to some highly complicated, almost meaningless ones that appear from time to time. Text figure 14a is especially good.

The three pages devoted to correlation are all too brief. Correlations are the payoff, so to speak, and are of the utmost importance. Chapters 13 and 14 on "Output and Dissemination" and "Surface Samples," contain the theoretical fundamentals for pollen analysis. Pollen production, weight, rate of sinking, and their dissemination by wind are fully dealt with, as are the composition of pollen rains, flotation, and water transport. A much needed discussion on the differential resistance of pollen is to be found in chapter 15. Herein lies one possible source of error in pollen analysis and it is gratifying to see at last that the full importance of this matter is made clear. The author's attempt at a geographical survey of pollen publications was necessarily interrupted by the war although a number of recent publications are listed at the end of the book.

Paleozoic prepollens and spores are little more than mentioned, but this is not truly the author's field. However, I feel it is most unfortunate that Ibrahim's scheme for classifying Paleozoic plant microfossils has been given further consideration. For many reasons too numerous to mention here, Ibrahim's taxonomic treatment of these Paleozoic plant microfossils is unsound. A complete taxonomic revision of the Paleozoic plant microfossils by Schopf, Wilson and Bentall is in press, which I firmly believe will help establish proper taxonomic treatment of these forms.

A concluding chapter on "Pollen Analysis of Honey and Drugs" is rather short but should interest those who desire to check the origin of certain commercial products.

In summation, Dr. Erdtman's book, is a work well done. Botanists, geologists, and others interested in pollen analysis will find it a true inspiration and guide.

R. M. KOSANKE
Illinois Geological Survey
Urbana, Illinois

REVIEW OF PETROLEUM GEOLOGY IN 1943, by F. M. Van Tuyl and others, Colorado School of Mines Quarterly, vol. 30, no. 2, 127 pp., April 1944, $1.00.

This excellent review of activities and accomplishments in the many related fields that are parts of or contribute to petroleum geology devotes 7 pages (50–56) to listing and briefly discussing about 50 of the more noteworthy paleontological publications of the past year, a large number of which appeared in this JOURNAL. These publications range from general reference works, bibliography, and description of technique to specialized papers devoted to paleobotany, sponges, Foraminifera, conodonts, ostracods, diatoms, graptolites, pollen, fish, crinoids, cephalopods, corals and pelecypods.

J. MARVIN WELLER

JOURNAL OF PALEONTOLOGY, VOL. 18, NO. 4, PP. 411–416, JULY 1944

SOCIETY RECORDS AND ACTIVITIES

REPORTS AND MINUTES OF THE EIGHTEENTH ANNUAL MEETING OF THE SOCIETY OF ECONOMIC PALEONTOLOGISTS AND MINERALOGISTS

The eighteenth annual meeting of the Society of Economic Paleontologists and Mineralogists was held in Dallas, Texas, March 23, 1944. The meeting was held in conjunction with the annual meeting of The American Association of Petroleum Geologists. The Council of the Society held its annual meeting on Tuesday, March 21. The following Council members were present: J. Harlan Johnson, president; and H. B. Stenzel, secretary-treasurer.

The regular program of the Society began at 10:00 A.M., March 23, and continued in the afternoon until 5:00 P.M. The following papers were presented by the authors:

J. Harlan Johnson, "Calcaerous Algae as Useful Microfossils."

W. S. Adkins, "*Mortoniceras verpertinum* (Morton)—Lower Cretaceous Ammonite Genotype."

H. B. Stenzel, "Cretaceous Crabs, Lobsters, and Shrimps from the Vicinity of Dallas."

Bruce L. Clark, "Problems of Speciation and Correlation as Applied to Marine Cenozoic."

Frank V. Stevenson, "New Aspects of the Devonian of New Mexico."

F. B. Plummer, "Formation of Travertine and Fresh Water Limestones."

The following papers were presented by title:

S. W. Lowman, "Progress Report on Relationship of Facies to Distribution of Foraminifera in the Northern Gulf of Mexico Region."

Charles E. Decker, "Bithecae in Graptolidea."

Paul D. Krynine, "Lithification and Diagenesis."

Paul D. Krynine, "Oil Fields in Time and Space."

H. B. Stenzel, F. E. Turner, and C. T. Hesse, "The Burkeville Fauna and Its Stratigraphic Implications Concerning the Miocene of the Gulf Coastal Plain."

The annual business session of the Society began at 11:00 A.M. Thursday, March 23. The following reports were given:

1. *Report of the Editor of the Journal of Paleontology* (J. Marvin Weller).—

Volume 17 of the Journal of Paleontology, issued in conjunction with the Paleontological Society in 1943, contains 641 pages and 109 collotype plates. Published in it are 42 paleontological papers, 1 paper each in the fields of bibliography, history, stratigraphy, biography, and technique, 11 notes, 6 reviews, and data relating to the activities and memberships of the two societies.

The March, July, and November issues were prepared by your editor in behalf of the Society of Economic Paleontologists and Mineralogists. These numbers consist of 280 pages and 39 collotype plates, a reduction of 113 pages and 9 plates below 1942. The contributions in these numbers may be classified as follows:

	Paleozoic	*Mesozoic*	*Cenozoic*
Foraminifera	1	1	3
Ostracods	1		1
Corals	1	1	1
Crinoids	1		
Asteroids		1	
Brachiopods	1		
Conodonts	3		
Faunas	1		

Three of these papers describe foreign species. In addition, three are devoted to stratigraphy, technique, and bibliography, respectively.

Reduction in the amount of published material by the Society has resulted from (1) an anticipated possible shortage of submitted manuscripts, (2) financial considerations, and (3) W.P.B. paper restrictions. The editor is happy to announce that the number of manuscripts received for publication has not fallen off as much as was expected and at the present time material sufficient to make up three numbers of the *Journal* is on file.

2. *Report of the Editor of the Journal of Sedimentary Petrology* (W. H. Twenhofel).—

The Journal of Sedimentary Petrology was published with the usual three numbers during 1943. In connection with the shortage of paper, attempts were made to reduce pages to such an extent as consistent with needs. A total of 130 pages and 2 pages of index were published. There were 15 articles and several reviews and discussions.

I think the JOURNAL enjoys an enviable position and that the articles which are appearing are of high grade. One has but to consult articles in the field of sedimentation and he will find that the number of references to articles in the Journal of Sedimentary Petrology usually exceeds references to any other journal. It is my regret that more articles are not submitted by members of the S.E.P.M. If the editor had to rely upon the membership in the Society for articles, the Journal could not be published. Fortunately, articles are submitted by outsiders and ordinarily it is possible to increase the membership in this way. I trust more may be done in that respect in the future.

At the present time enough articles are on hand to publish the second number of 1944 with one or two articles in addition. This is not as healthy a condition as is desirable, but, perhaps, it is the best that may be expected under war conditions.

3. *Report of the Secretary-Treasurer* (H. B. Stenzel).—

BACK VOLUME SALES

Back volumes of the Journal of Paleontology	$348.70
Back volumes of the Journal of Sedimentary Petrology	$179.30

PRINTING AND ENGRAVING BILLS FOR 1943

Journal of Paleontology

	Banta Printing Bills	*Meriden Engraving Bills*	*Total Printing and Engraving Bills*	*S.E.P.M. Total Printing and Engraving Bills*
Number 1 (January)*	$ 678.77	$ 463.11	$1,141.88	
Number 2 (March)	667.03	308.46	975.49	$ 975.49
Number 3 (May)*	709.25	473.27	1,182.52	
Number 4 (July)	651.55	289.77	941.32	941.32
Number 5 (September)*	818.05	680.54	1,498.59	
Number 6 (November)	756.40	337.05	1,093.45	1,093.45
	$4,281.05	$2,552.20	$6,833.25	$3,010.26
(1942 Totals)	($5,513.96)	($2,627.69)	($8,141.65)	($3,947.55)

*Odd numbers paid for by Paleontological Society.

Journal of Sedimentary Petrology

	Banta Printing Bills
Number 1 (April)	$272.99
Number 2 (August)	277.85
Number 3 (December)	300.47
	$851.31
(1942 Total)	($921.01)

MEMBERSHIP, MAILING, AND JOURNAL STATISTICS

	March 1944	*March 1943*	*March 1942*
1. S.E.P.M. Membership:			
Active Members	254	251	264
Associate Members	69	66	74
Total	323	317	338

2. Journal of Paleontology Mailing List:			
S.E.P.M. Active Members	203	215	219
S.E.P.M. Associate Members	47	44	48
S.E.P.M. Subscribers	283	255	244
P.S. Members	323	323	336
Total	856	837	847
3. Journal of Sedimentary Petrology Mailing List:			
S.E.P.M. Active Members	116	114	127
S.E.P.M. Associate Members	19	19	22
S.E.P.M. Subscribers	213	213	239
Total	348	346	388
4. Number of pages in 1943 Journal of Paleontology	641 (793, 1942)		
5. Number of plates in 1943 Journal of Paleontology	109 (118, 1942)		
6. Total edition of 1943 Journal of Paleontology	1300 (1300, 1942)		
7. Number of pages in 1943 Journal of Sedimentary Petrology	130 (147, 1942)		
8. Total edition of 1943 Journal of Sedimentary Petrology	500 (500, 1942)		
New members from March 1, 1943, to March 1, 1944	13 (4, 1942–1943)		
New associates from March 1, 1943, to March 1, 1944	8 (8, 1942–1943)		
Transfers to active membership, March 1, 1943, to March 1, 1944	2 (9, 1942–1943)		

FINANCIAL STATEMENT FOR THE YEAR 1943

To the Council, Society of Economic Paleontologists and Mineralogists.

In continuation of our examinations in prior years we have examined the accounting records of the SOCIETY OF ECONOMIC PALEONTOLOGISTS AND MINERALOGISTS for the year ended December 31, 1943, and now present our report together with the following statements:

Exhibit

A Statement of Financial Condition, December 31, 1943

B Statement of Income for the year ended December 31, 1943

Schedule

1 Statement of Receipts and Disbursements for the year ended December 31, 1943.

In connection with our examination, we reviewed the system of internal control and the accounting procedures of the Society and, without making a detailed audit of the transactions, have examined or tested accounting records of the Society and other supporting evidence, by methods and to the extent we deemed appropriate. Our examination was made in accordance with generally accepted auditing standards applicable in the circumstances and included all procedures which we considered necessary.

Inventory of publications represents approximately 30,150 Journals (exclusive of Journals in excess of complete sets for issues prior to 1943) including certain issues printed at the expense of the Paleontological Society for the years 1935 to 1943, inclusive, stated at appraised values of fifty cents each for Journals printed prior to 1943 or cost to either the SOCIETY OF ECONOMIC PALEONTOLOGISTS AND MINERALOGISTS or the PALEONTOLOGICAL SOCIETY for Journals printed in 1943. The SOCIETY OF ECONOMIC PALEONTOLOGISTS AND MINERALOGISTS has agreed to distribute a portion of its income to the Paleontological Society; the amount accruing to the latter for the year 1943 amounted to $341.03.

In our opinion the accompanying statement of financial condition and related statement of income present fairly the position of the SOCIETY OF ECONOMIC PALEONTOLOGISTS AND MINERALOGISTS at December 31, 1943, and the results of its operations for the year, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

(Signed) ARTHUR YOUNG & COMPANY, *Accountants and Auditors*

TULSA, OKLAHOMA
February 7, 1944

EXHIBIT A

STATEMENT OF FINANCIAL CONDITION, DECEMBER 31, 1943

ASSETS

CURRENT ASSETS:		
Demand deposits—		
The First National Bank and Trust Company, Tulsa, Oklahoma	$ 3,368.36	
National Bank of Commerce, Tulsa, Oklahoma	107.25	$ 3,475.61
Savings deposit—		
The First National Bank and Trust Company, Tulsa, Oklahoma		2,209.51
Accounts receivable—		
Printed matter less reserve of $84.00	$ 52.50	
Other	11.91	64.41
TOTAL CURRENT ASSETS		$ 5,749.53
INVENTORY OF PUBLICATIONS—see report		16,111.37
FURNITURE AND FIXTURES	$ 482.60	
Less: Reserve for depreciation	288.98	193.62
DEFERRED CHARGE:		
Prepaid printing		325.54
TOTAL ASSETS		$22,380.06

LIABILITIES AND SURPLUS

CURRENT LIABILITIES:		
Accounts payable		$ 638.73
Accrued taxes		11.28
Amount due to Paleontological Society		341.03
TOTAL CURRENT LIABILITIES		$ 991.04
DEFERRED INCOME:		
Subscriptions to Journals	$ 1,465.95	
Membership dues for 1944 and 1945	825.66	2,291.61
SURPLUS:		
Balance, December 31, 1942	$18,471.28	
Net income for the year ended December 31, 1943 (Exhibit B)	626.13	
Balance, December 31, 1943		19,097.41
TOTAL LIABILITIES AND SURPLUS		$22,380.06

SUBJECT TO COMMENTS IN ACCOMPANYING REPORT

EXHIBIT B

STATEMENT OF INCOME FOR THE YEAR ENDED DECEMBER 31, 1943

OPERATING INCOME:		
Dues and subscriptions—		
Journal of Paleontology and Sedimentary Petrology		$ 728.00
Journal of Paleontology		2,559.10
Journal of Sedimentary Petrology		762.12
		$4,049.22
Sales of back numbers—		
Journal of Paleontology	$ 439.70	
Journal of Sedimentary Petrology	189.00	628.70
Sales of plates and reprints		308.15
Advertising		63.10
		$5,049.17
Less: Proportion of income accrued to Paleontological Society		341.03
		$4,708.14

COSTS AND EXPENSES:		
Cost of printing—		
Journal of Paleontology	$3,106.56	
Journal of Sedimentary Petrology	942.78	
	$4,049.34	
Clerical salaries	881.00	
Office rent	310.00	
Postage and mailing	348.25	
Audit fee	100.00	
Office supplies and expenses	103.64	
Depreciation	48.26	
Taxes	32.62	
Other costs and expenses	78.19	
	$5,951.30	
Less: Increase in inventory of publications	340.86	5,610.44
		$—*902.30*
NON-OPERATING INCOME:		
Donation from American Association of Petroleum Geologists	$1,500.00	
Interest on savings deposit	21.92	
Miscellaneous	6.51	1,528.43
NET INCOME		$ 626.13

SUBJECT TO COMMENTS IN ACCOMPANYING REPORT

SCHEDULE 1

STATEMENT OF RECEIPTS AND DISBURSEMENTS FOR THE YEAR ENDED DECEMBER 31, 1943

DEMAND DEPOSITS, DECEMBER 31, 1942			$2,561.76
RECEIPTS:			
Membership dues and subscriptions—			
Year 1943—			
Journal of Paleontology and Sedimentary Petrology	$ 808.00		
Journal of Paleontology	2,303.40		
Journal of Sedimentary Petrology	724.82	$3,836.22	
Years 1944 and 1945—			
Journal of Paleontology	$ 466.15		
Journal of Sedimentary Petrology	158.60	624.75	
Sales of back numbers—			
Journal of Paleontology	$ 270.70		
Journal of Sedimentary Petrology	103.80	374.50	
Sales of plates and reprints		304.24	
Accounts receivable		225.35	
Donation from American Association of Petroleum Geologists		1,500.00	
Miscellaneous		289.65	7,154.71
			$9,716.47
DISBURSEMENTS:			
Printing expenses—			
Journal of Paleontology	$2,074.98		
Journal of Sedimentary Petrology	821.84		
Engraving Journal of Paleontology	935.28	$3,832.10	
Postage and mailing		223.15	
Office rent		310.00	
Clerical salaries		800.28	
Audit fee		100.00	
Payment to Paleontological Society		336.80	
Editorial salaries		295.00	
Taxes		112.81	
Refunds on subscriptions		14.67	
Office supplies and expenses		37.00	
Miscellaneous		179.05	6,240.86
DEMAND DEPOSITS, DECEMBER 31, 1943			$3,475.61

SUBJECT TO COMMENTS IN ACCOMPANYING REPORT

4. *Report of Two Resolutions Committees* (John R. Sandidge, chairman 1; N. L. Thompson, chairman 2).—

(1) WHEREAS we have received sad news of the passing of Mr. Frederick Chapman, naturalist and geologist, we, the members of the Society of Economic Paleontologists and Mineralogists, extend to his family our sincere sympathy. Mr. Chapman died at the age of 79, on December 10, 1943, in Melbourne, Australia, where he had lived for about 45 years. Mr. Chapman led a zestful and enthusiastic life with broad scientific interests, and his contributions were distributed not only over the several fields of geologic science but also in botanical and horticultural fields. His extensive paleontologic studies of ostracode and foraminiferal faunas throughout the geologic section and of the same groups in waters of the South Pacific have been of special significance during recent years, though his contributions in paleobotany and larger invertebrates must also be recognized. His generosity of spirit in aiding younger workers made him greatly beloved by a host of friends and admirers.

(2) *Be It Resolved* that we, the Society of Economic Paleontologists and Mineralogists, express appreciation and thanks to The American Association of Petroleum Geologists and the Dallas Petroleum Geologists for their efforts in making the annual meeting at Dallas an outstanding success.

It was moved, seconded, and carried that all reports be accepted.

5. Secretary-Treasurer Stenzel announced the newly elected officers of the Society as follows:

President.....Donald D. Hughes
Vice-President.....Hershal C. Ferguson
Secretary-Treasurer.....H. B. Stenzel

The meeting adjourned at 5:00 P.M. Thursday, March 23, 1944.

ERRATA

SOME LARGER FORAMINIFERA FROM THE LOWER CRETACEOUS OF TEXAS: CORRECTIONS

R. WRIGHT BARKER
Shell Oil Company, Inc., Houston, Texas

Through an oversight several important proof corrections were not made in the final copy of my paper "Some Larger Foraminifera from the Lower Cretaceous of Texas" (this JOURNAL, vol. 18, no. 2, pp. 204–209, March 1944). These corrections are as follows:

p. 204—Plate explanation at foot of page: the magnifications should read as follows: figs. 1, 2 and 3, for "×100" read "×80 approx."; fig. 4 for "×50" read "×40 approx."; fig. 5 for "×25" read "×20 approx."; fig. 6 for "×20" read "×16 approx."; figs. 7 and 8 for "×40" read "×32 approx."; fig. 9 for "×25" read "×20 approx."; figs. 10, 12, 13 and 14 for "×4" read "×3.2 approx."; fig. 11 for "×20" read "×16 approx."; figs. 15 and 16 for "×20" read "×16 approx.".

p. 205—Left column, line 37: for "*Eorupteria* read "*Eorupertia*"; right column, line 30, for "microphotographs" read "photomicrographs."

p. 207—Right column, lines 9 to 11, for "So far as known it is the oldest recorded and only Cretaceous species of *Coskinolina* . . ." read "So far as known it is the oldest recorded American species of *Coskinolina* . . ." (The reference to Pfender, pp. 204–205, was originally in the form of an appendix, written after the paper was completed, and its insertion in the early pages of the account alters the remarks on p. 207); line 30, for "Holotypes" read "Holotype."

p. 209—Left column, line 43, for "indicates beds of Aptian age" read "indicates beds of Upper Aptian-Albian age."

p. 209—Right column, line 40, for "*Coskinolina liburnica* Stache d. geol. Reichsanst. Wien Jahrb.," read "*Coskinolina liburnica* Stache, etc.,: geol. Reichsanst. Wien Jahrb.,".

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UNITED STATES AND CANADA

A SYMPOSIUM

CONDUCTED BY THE RESEARCH COMMITTEE OF
THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS

Edited by A. I. LEVORSEN

Contents

Foreword	By A. I. Levorsen	1
Alaska	By Philip S. Smith	8
Western Canada	By Alberta Society of Petroleum Geologists	15
Pacific Coast States	By Pacific Section, American Association of Petroleum Geologists	25
Rocky Mountain Region	By Rocky Mountain Association of Petroleum Geologists	37
Northern Mid-Continent States	By Tulsa Geological Society	76
West Texas	By West Texas Geological Society	95
Eastern Canada	By Geological Survey of Canada, Quebec Bureau of Mines, and Newfoundland Geological Society	107
Eastern United States	By Appalachian Geological Society	131
Southeastern United States	By Mississippi Geological Society	143

Comment

Economic Geology (Oct.-Nov., 1941).—"Each section deals with geological sections, stratigraphy, and structure, and is illustrated by maps and sections, and accompanied by selected references. . . . The book not only gives a picture of the places of future oil discoveries in this vast area, but is also a geological handbook of the areas."

A.P.I. Quarterly (Oct., 1941).—"The volume indicates no lack of geological structure favorable for the accumulation of oil. Essential book for the oil man's library."

I.P.A.A. Monthly (Sept., 1941).—"Publication of these reports is opportune. . . . What the geologists have done is to indicate enormous territory that possesses geological requisites for oil formation and accumulation."

Oil (Oct., 1941).—"It is not only valuable as a reference book, the findings of our foremost geologists—but also for its suggestive quality, as a stimulant to the imagination, an inspiration to further research in field and laboratory . . . probably the best bargain in the way of reading matter that the oil man is likely to get in a long time."

Journal, Inst. of Petroleum (Jan., 1942).—"The volume constitutes a peak even on the high plateau of achievement of this leading association of petroleum geologists."

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